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Municipal Engineering

The World's Leading Municipal Publication

WHAT IS AN ENGINEER?

A special committee of the American Society of Civil Engineers on Engineering Education has been working on its subject for several years. It has gone so far as to ask the members of engineering societies for their ideas of the fundamental characteristics necessary to success in engineering and to analyze the 1,500 answers to this question which it has received. The result thus far has been to classify these answers and to send out a second inquiry in which the groups of qualities are arranged in their order of importance as indicated by the vote. Thus character, including integrity, responsibility, resourcefulness, initiative, stands first with 41 per cent. vote, then in order, judgment, 17½ per cent.; efficiency; understanding of men; knowledge of the fundamentals of engineering science, 7 per cent.; technique of practice and of business, 6 per cent. Each voter is required to arrange these six qualities in the order of importance in his opinion as applied to an applicant for an engineering position. The idea seems to be that from these replies a formula for the product business and professional men want from a technical school can be made and then the schools will attempt to fill the demand.

The first six of these groups of qualities had 87 per cent. of the votes on the first ballot. The first three are not peculiar to engineers or to the product of engineering schools, but are what are necessary to the fullest success of any man in any business or profession. Their development should be the aim of every school of every kind, including engineering schools. The latter schools have sometimes been criticized because they had a tendency to neglect these qualities, and in so far it may be well to include them in the formula. The third group, efficiency, may well be emphasized from the practical point of view. Development in the first and second groups is the product far more of daily life and conduct than of school instruction, but neither should be lost sight of for a moment in the daily intercourse during school life, tho definite daily detailed instruction may be conspicuous, as it usually is, by its absence.

In short, the first and second groups are not peculiar to engineering schools, nor to schools in general, being rather the product of example and influence than of precept from outside, but mainly the product of the life of the young man of which his school life occupies but a small proportion after all.

The fourth group, the understanding of men, including executive ability, is again not greatly dependent upon definite instruction, but its development in the young man is induced by the practice of the art of doing things rather than the study of the science of doing them. So far as the latter study is concerned, it is an accompaniment of the study required to meet the requirements of the fifth and sixth groups and will aid the practice of the art of doing things, and as such should occupy a prominent place in the curriculum.

The six groups thus reduce, so far as the special work of the technical school is concerned to the last two, the scientific part of the fourth and the practical part of the third, these two being placed last because only the barest fundamentals can in any event be given during the college course. The first three are demanded of all educational activities of any kind whatever, and a technical school which is lacking in them is lacking in the first principles of an educational program. Any school lacking in them is not a true educational institution.

PAVED ROADS AND PREPAREDNESS

A large committee of engineers, with members from every state, has been appointed to make an industrial census to determine what the country has which could be made available on short notice in case of war. The civil engineers on the committee desire to extend the scope of the census to cover bridges and roads. We make room for an article by Major P. S. Bond, demonstrating the necessity of paved roads in modern warfare, more particularly along the probable battle fronts. As Major Bond says, we have the railroads, we have the automobiles, and we have the facilities and materials for making the necessary supplies and promptly renewing all these things as required.

But we do not have the roads. And roads take time to build. The conclusion is inevitable that the first step in a program of preparedness is the location and construction of the necessary roads. Everything else can be taken care of after war is declared, if necessary, but after war is declared, no adequate solution of the road question can be found. Fortunately, preparedness for war in the supplying of good roads is at the same time the best possible preparedness for peace, and even those who are crying for peace at any price cannot condemn such a step toward preparation.

If the engineers of the country will join with the army officers in a campaign on Congress for paved roads, they can put them thru. All that is needed is a pull altogether. Begin the campaign as individuals. Write to your representatives and your senators. Organization will soon follow.

SEWAGE TREATMENT PLANT

AT ROCHESTER, NEW YORK

The new sewage disposal plant at Rochester, N. Y., which will partially treat the sewage of that city in Imhoff tanks prior to discharging it into Lake Ontario, will be ready for operation some time this year. This brief description of the plant, taken from an article by C. Arthur Poole, C. E., general assistant engineer in charge of the sewage disposal plant, is timely and should give a clear idea of what is to date probably the largest installation using this method which has yet been constructed.

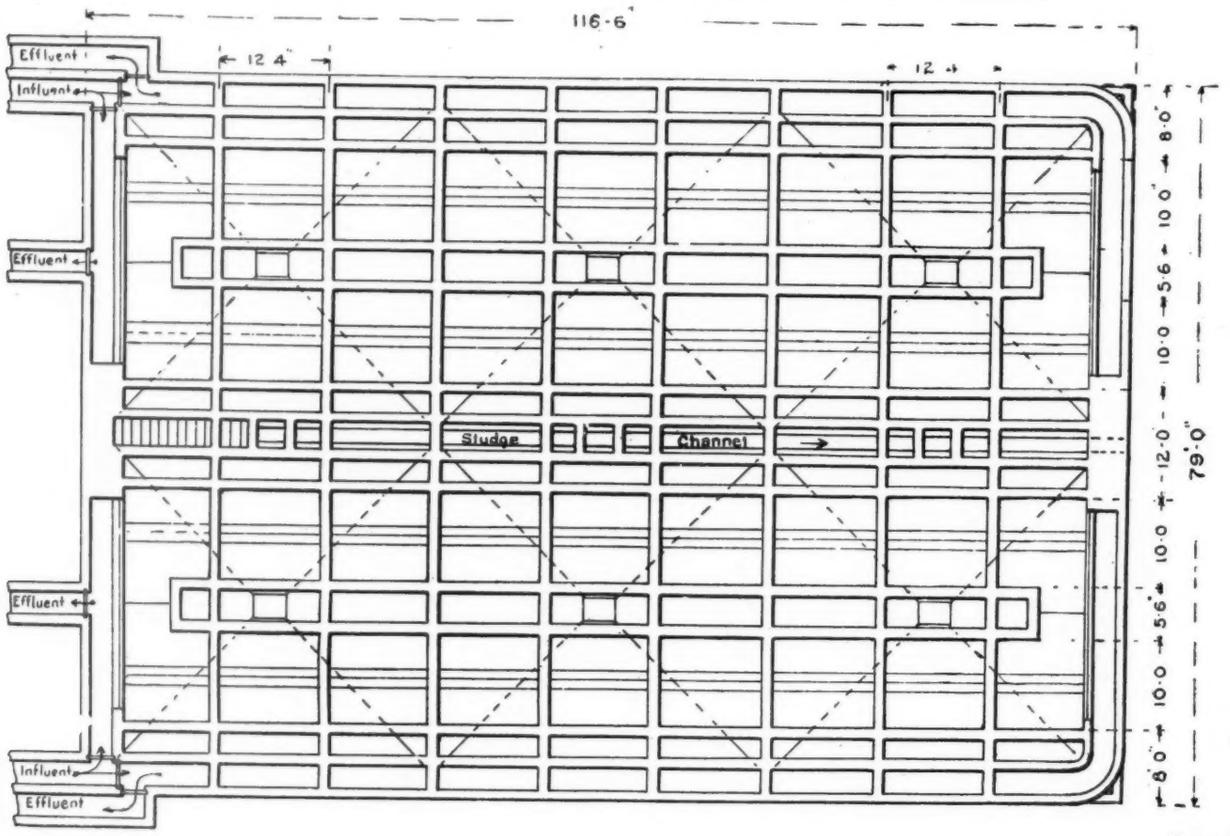
THE sewage of Rochester, N. Y., is collected from the main sewers of the city by an intercepting sewer and carried to a treatment plant in the town of Irondequoit, near Lake Ontario, the treated effluent being discharged thru an outlet pipe into the lake 7,000 feet from shore, where the water is 50 feet deep.

The intercepting sewer discharges the sewage into six detritus tanks arranged side by side, the entrance to each tank being provided with a coarse rack with 2-inch openings for rough screening. A gate at the entrance of each tank makes it possible to use at any time any desired tanks. Each tank is 90 feet long and 10 feet wide and has an effective depth of 3 feet, so that about 100 cubic yards of grit can accumulate before cleaning. An excavating machine does the cleaning mechanically, drainage being provided for during cleaning by a system of underdrains. At the outlet end of each tank is a revolving screen with ½-inch openings, mechanically cleaned, for a careful screening of the sewage before it passes to the main influent channel for distribution to Imhoff tanks.

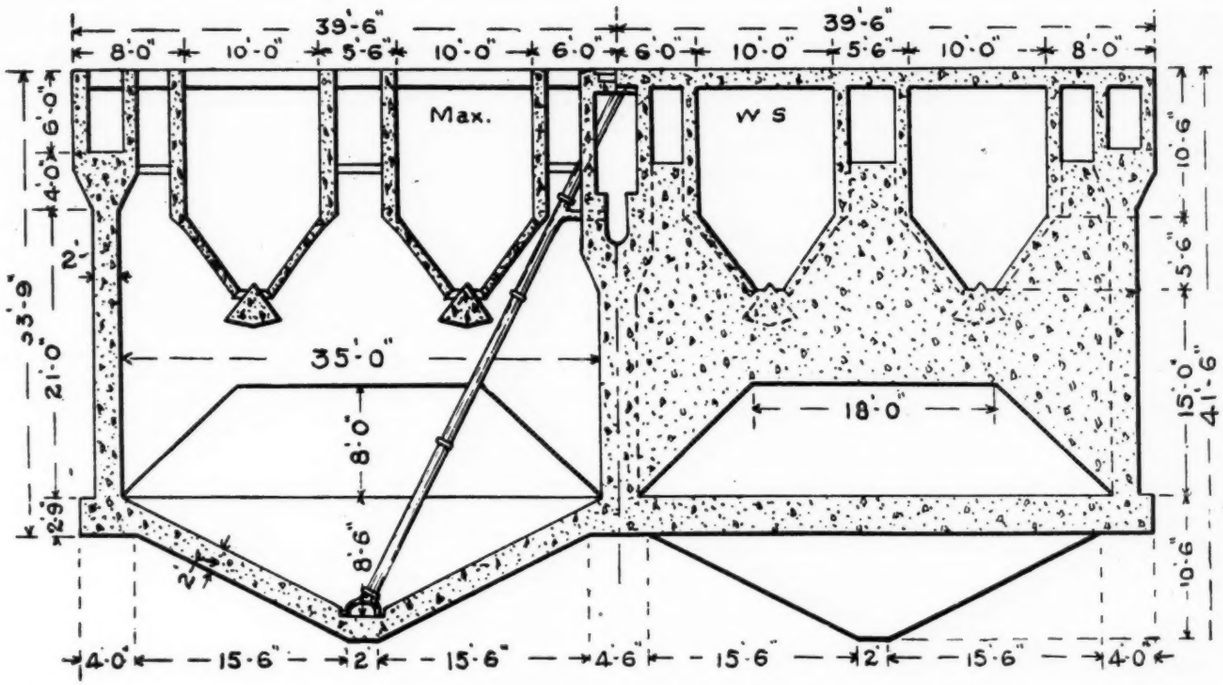
The plans provide for 10 Imhoff tank units, each with a capacity to handle the sewage from 40,000 people. As the population of Rochester is but 250,000 at present, only 7 of these units are constructed at this time, the others to be added as the growth of the city may demand.

Each unit is practically six Imhoff tanks, in two sets of three each, the sets being arranged side by side. The drawing of the plan of a double Imhoff tank shows the arrangement of the six tanks with the sludge channel running between the two sets of three each.

Five of the units are placed on each side of the main influent channel, which is about 395 feet long, each unit, as shown on the drawing, being 79 feet wide, measured on the line of the influent channel, the entire plant being about 435 feet long..



PLAN OF A DOUBLE IMHOFF TANK. SLUDGE CHANNEL RUNS BETWEEN THE TWO TANKS. EACH TANK HAS THREE HOPPER BOTTOMS AS SHOWN FOR COLLECTION OF SLUDGE AT ENTRANCE TO PIPE OUTLET, WHENCE THE SLUDGE IS RAISED THRU THE PIPE TO THE SLUDGE CHANNEL BY THE PRESSURE OF THE WATER IN THE TANK ABOVE. NOTE INFLUENT AND EFFLUENT CHANNELS AND STOP PLANKS, BY THE PLACING OF WHICH THE FLOW OF SLUDGE CAN BE CHANGED TO PASS THRU EITHER TANK IN EITHER DIRECTION.



CROSS SECTION OF DOUBLE IMHOFF TANK. THE SECTION OF THE LEFT TANK IS THRU THE BODY OF THE TANK, SHOWING THE SLOPING BOTTOMS OF THE DIVISIONS BETWEEN THE UPPER AND LOWER PARTS OF THE TANK; THE TRIANGULAR KEY IN THE OUTLET SLOT OF THESE SLOPING BOTTOMS, THE REINFORCING RODS IN WHICH SERVE AS TIES BETWEEN THE END WALLS OF THE TANKS; CROSS SECTIONS OF THE INFLUEHT AND EFFLUENT CHANNELS, AND OF THE SLUDGE CHANNEL. NOTE ALSO THE OUTLET PIPE FOR SLUDGE DISCHARGE RUNNING FROM THE BOTTOM OF THE HOPPER UP TO THE SLUDGE CHANNEL, AND EXTENDING, FOR INSPECTION, CLEANING AND DILUTION PURPOSES, UP TO THE CENTRAL WALK RETWEEN THE TANKS.

Each tank in a unit is 110 feet long and 35 feet wide, with a maximum depth of 40 feet. With the various influent, effluent and sludge channels the outside dimensions of a unit shown on the drawing are made up, viz: 79 feet along the main influent channel and 116.5 feet perpendicular to it.

Sewage may be admitted to any tank by the operation of gates, admitting the influent sewage to channels around the pair of tanks in a unit. These channels are so arranged that the influent sewage can be admitted to either end of a tank and the effluent sewage discharged from the opposite end, making it possible to reverse the flow of sewage thru the tank. The alternative routes of influent sewage and of effluent sewage are indicated by the arrows on the drawing. This reversal of flow is desirable especially during the winter time when, sometimes, sludge can not be removed from the tanks for 150 days, so that the deposit of the sludge can be equalized over the entire area of the tank.

According to the usual designs for Imhoff tanks, the upper part of each tank is separated from the lower part by partitions with sloping bottoms which form in each tank two long parallel V-shaped troughs, each 10 feet wide and 12 feet deep at the center line, measuring from the surface of the water to the 6-inch slot at the bottom of the trough, thru which the matter settling out of the sewage standing above enters the compartment below in which this sludge is digested.

The drawing marked "Section of Double Imhoff Tank" shows a cross-section of the pair of tanks in a unit, the section of the left tank of the pair being thru the body of a tank and that of the right thru one of the supporting partitions carrying the troughs and roofs above. The troughs described above are shown, the sloping bottoms, 5 inches thick, being on an angle of 1 horizontal to 1⅜ vertical. The method of preventing the escape of gas from the fermenting sludge below thru the slot in the bottom of the trough is shown in the roughly triangular cross section of the concrete bar which shunts the sludge each way from the center as it is going down and turns the gas away from the slot as it passes up thru the water. Between the troughs is a gas slot 3 feet wide into which the gas rises from the sludge below.

This lower section of each tank has three hopper-shaped depressions in its bottom, each 35 feet square at the top and 8 feet deep, the hopper bottoms being 15 feet below the slot in the bottom of the upper section of the tank. This volume of space gives storage for 40,000 cubic feet of sludge or 20,000 people for each tank of a pair, which will be sufficient for the 150 winter days above referred to, on the basis of 2 cubic feet of sludge from each person in that time.

The flow of sewage from the main influent channel into the channel serving each unit will be automatically controlled at any rate desired by means of an adjustable float in the influent channel. The change in direction of flow into the individual tanks will be made by hand.

The clarified effluent from the tanks flows to the main effluent channel, which runs parallel with the main influent channel. The dry-weather effluent flow passes into a 48-inch pipe which carries it to the power station in the plant where it has fall enough before reaching the level of the outlet pipe to the lake to generate power with which to light and operate the plant. The storm flow overflows directly into the outlet pipe to the lake.

The sludge which gathers in the hoppers in the bottom of the Imhoff tanks is drawn off thru pipes which discharge into a channel about 5 feet lower than the water surface in the tanks, head enough to force the sludge out thru the pipes. The sludge channel is located between the two tanks in a pair as shown on the plan and also in the sectional drawing. This channel takes the sludge to the drying beds, which have an area of one square foot for each three persons of the city population. These beds have 19 inches depth of filtering material laid in layers of graduated sizes of material and one under-drained with 3-inch tile, laid 18 feet apart. The beds are

in sections each about 40 feet square. Depressed tracks running lengthwise of the beds between sections supply car service for removing the dried sludge.

The outside walls of the Imhoff tanks proper are 2 feet thick, designed to resist an earth pressure from backfill to top of wall on the outside and a maximum depth of 27 feet of water on the inside. There is one of the transverse walls shown in the cross section of the right-hand tank in the drawing every 12 feet 4 inches, cutting the outside wall into panels. These 18-inch transverse walls carry the troughs, etc., above and serve as buttresses against outside pressure and ties against that from the inside. In the side walls at each transverse wall are placed two 10-inch channels, 24 feet long, acting as pilasters. Six 1¾-inch tie-rods in the transverse walls, attached to these pilasters, tie the side walls together. End walls are tied together in like manner, the tie rods running from end to end of the tanks in the triangular concrete sections located in the slots at the base of the sloping bottoms of the upper part of the tanks. Horizontal reinforcement in panels is ¾-inch, bars closer spaced toward the bottom of the wall. The middle longitudinal wall between the two tanks is 30 inches thick, reinforced to carry water pressure with either tank full and the other empty.

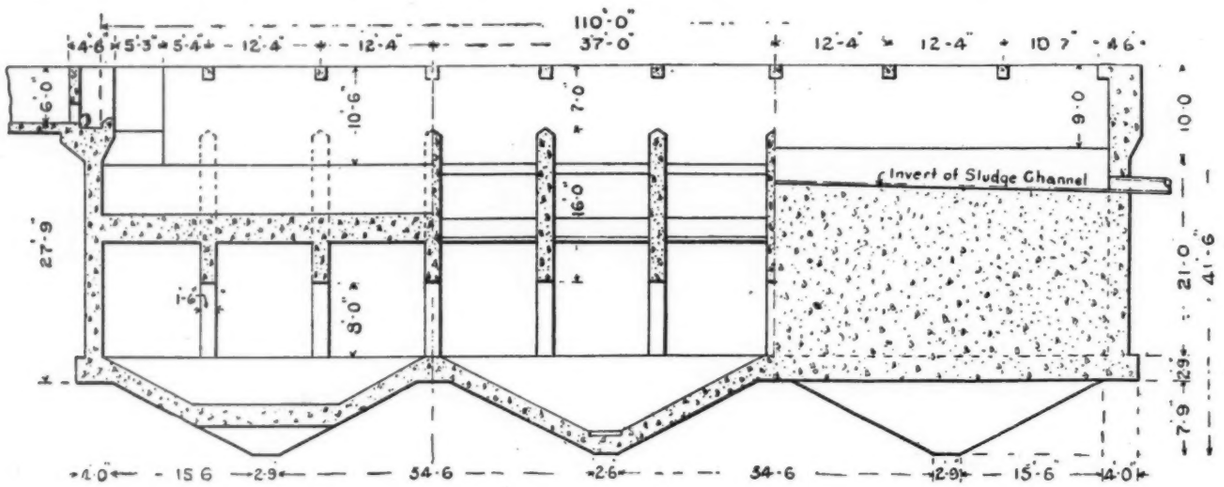
It will be noted that all the tanks are rectangular in form.

The entire structure is waterproofed by the integral method using Trus-Con waterproofing paste, 6 pounds to each cubic yard of concrete. The paste is diluted with water 1 to 1 and then put on the aggregate in the mixer just before the water is turned in. It is thus thoroly mixed in the concrete.

The work is well under way and promises to be near completion at the end of this season.

The plant was designed under the supervision of E. A. Fisher when city engineer and the late Emil Kuichling, consulting engineer. The construction is under the immediate charge of C. Arthur Poole, general assistant engineer for the sewage plant, to whom we are indebted for data. Myers and McWilliams, Rochester, N. Y., are the contractors.

LONGITUDINAL SECTION OF IMHOFF TANK. THE LEFT ONE-THIRD OF THE SECTION IS THRU THE TANK AT A POINT TO SHOW THE GENERAL LOCATION OF CROSS SUPPORTING WALLS AND VERTICAL SECTION OF THE SLOPING BOTTOM OF THE UPPER DIVISION OF THE TANK. THE MIDDLE ONE-THIRD IS TAKEN ALONG THE CENTER LINE, SHOWING THE HOPPER BOTTOM AND THE LOCATION OF THE SLOT IN THE SLOPING BOTTOM OF THE UPPER DIVISION, AND SECTIONS OF THE CROSS SUPPORTING WALLS. THE RIGHT ONE-THIRD IS TAKEN THRU THE WALL BETWEEN THE TWO TANKS OF THE PAIR AND SHOWS THE LONGITUDINAL SECTION OF A PART OF THE SLUDGE CHANNEL. THE DIMENSIONS ARE SELF-EXPLANATORY.



Reproduction Cost as Purchase Price of Water Works

For the first time, so far as is known in the history of New England water works systems, the price to be paid by the city of Bath, Me., to the Maine Water Company is less than the estimated reproduction cost of the plant. The price is $539,500, nearly $2,000 less than the reproduction cost, as determined by the joint conference of the engineers representing both sides.

This price was agreed upon by two engineers, Mr. Frederic H. Fay, of Fay, Spofford & Thorndike, consulting engineers, Boston, Mass., and Mr. William B. Getchell, of Augusta, Me., selected as the two arbitrators by the Bath Water District and the Maine Water Company, respectively, with power to choose a third arbitrator in the event of a disagreement. These two engineers, however, came to an agreement without the necessity of calling in the third man. Both parties to the contract are satisfied and all litigation expenses have been avoided.

The unusual feature of this transaction, aside from the business-like manner in which it was conducted, is the relation of the price to the reproduction cost of the plant as already pointed out. As will be noted in the following table, the usual purchase price for water systems thruout New England has been on the average one and a half times the reproduction cost:

Place	Reproduction Cost	Award	Ratio, award to reproduction Cost
Gardiner, Me.	$ 132,000	$ 245,000	1.85
Waterville, Ma.	368,546	503,475	1.37
Augusta, Me.	287,279	427,135	1.48
Kittery, Me.	102,510	163,869	1.60
Livermore Falls, Me.	85,394	117,698	1.38
Portland, Me.	2,853,696	3,963,034	1.38
Gardner, Mass.	165,000	274,000	1.66
Athol, Mass.	206,386	316,500	1.53

Wood Blocks for Street Paving

THEIR TREATMENT AND HANDLING

Treatment of wood blocks for use in street paving has not yet been standardized. Two societies, one of wood block manufacturers and one of municipal officials, have been at work on the problem for several years, and no specifications have been adopted by either one as yet. The comparison in this article of the specifications under consideration by these societies with modifications proposed by others and with the Toronto specifications covers all the various classes of oil in use and may help to clarify the situation. Suggestions and discussions are invited.

THE American Society of Municipal Improvements has just issued a booklet containing the specifications for wood block paving presented by its special sub-committee at the convention held in Dayton, Ohio, last October. The specifications were subject to considerable discussion, partly as to the report itself and more fully in the discussion of papers on the subject by E. P. Dutton, chairman of the committee, J. W. Howard, P. C. Reilly and H. Von Schrenk. As full agreement was not reached the specifications were not adopted and were laid over for consideration at the convention to be held in Newark, N. J., October 9-13, 1916. At the same time an invitation was extended to those interested to send in suggested changes in or modifications of the specifications for oils with which to treat the blocks. The booklet contains, in addition to the report of the committee, such suggestions from P. C. Reilly, president of the Republic Creosoting Co.; W. H. Fulweiler, chemist of the United Gas Improvement Co.; C. N. Forrest, chemist of the Barber Asphalt Paving Co., and J. W. Howard, consulting engineer on roads and pavements.

The city of Toronto, Ont., purchases treated wood blocks ready for laying in pavements, and either lays them by city-employed labor or lets the contract for laying them together with that for grading and foundation. Bids for the year 1916 were received in December on specifications which differ in some respects quite materially from any of those in the booklet referred to, particularly with respect to the oil for treating blocks.

It will be worth while to compare these specifications and such a comparison follows, the data being arranged so as to make the comparison as easy as possible. It should be stated that the same report presented to the American Society of Municipal Improvements was later presented to the Wood Preservers' Association and was not adopted by that organization but was ordered printed as information. Discussion of the data here presented is invited and suggestions of other specifications than those given may be made with such reasons for the differences as seem pertinent and such data as form the basis for the suggestions so made. Data as to cost of the treated blocks ready for laying, with full data as to oils used, methods and results of treatment are also invited for comparison.

Specifications for Preservative.

In the following reference letters are used for the authorities as follows:

A—Sub-committee of A. S. M. I.
B—P. C. Reilly.
C—J. W. Howard.
D—R. C. Harris, Commissioner of Works, Toronto, Ont.
E—W. H. Fulweiler.
F—C. N. Forrest.

DESCRIPTION OF OIL.

A—Wholly derived from coal gas tar or coke oven tar.

B—Obtained by the distillation of coal tar and consisting wholly of such distillate from coal tar as will comply with the following requirements.

C—Distillate made from coal-tar or a combination of distillates from coal-tar and water-gas tar, provided the oil produced meets all the tests of qualities needed for thoroly preserving wood stated below.

D—Pure coal-tar creosote, consisting of any and all distillate oils boiling above 170° C., which are obtained by straight distillation of coal tars consisting principally of compounds belonging to the aromatic series and containing well-defined amounts of phenoloids. It shall be free from all adulteration and shall not contain any tar, oil or residue obtained from petroleum or any other source, including coal-gas tar or coke-oven tar.

E—Product of water-gas tar and free from admixture of other crude or unrefined tars.

F—Refined water-gas tar complying with following requirements.

SPECIFIC GRAVITY AND DISTILLATION FRACTIONS.

Authority.	Sp. Gr. 38°C	Distillation Fractions—(Percentages) 0-200°	200-210°	210-235°	235-315°	315-355°
A	1.06—1.12	a5	....	30—	35—70	65+
B	1.12—1.14	b	b	b	15—	40—
C	1.03+	c5	....	....	.....	....
D	1.03—1.07	2	3	5—30	40=	25—55
E	1.11—1.14	d3	....	10—	40—	25+
F	1.12—1.14	a5	....	15—	40—	25+

= following figure indicates more or less.
— following figure indicates maximum permissible.
+ following figure indicates minimum permissible.
a 0° to 210° not more than 5%.
b 0° to 250° not over 1%.
c 0° to 150° not over 1%.
d 0° to 210° not to exceed 3%.

OTHER REQUIREMENTS.

Insoluble with benzol and chloroform: A, 3—; C, 1—; E, 2—; F, 2—.

Specific gravity of distillate at 38°C: Between 235° and 315° C; A, 1.02—; E, 0.96—1.00. Between 315° and 355°C, A, 1.08—; F, 1.00 for total below 355°C. Between 400° and 420°C; B, 1.12—.

Specific viscosity at 82°C.: A, 1.3—.

Water content: A, 3—; D, 2—; F, 2—.

Foreign matter: A, not more than 2% of sawdust, dirt, etc., and for such and for water and benzol and chloroform insoluble, corresponding increase in weight of oil injected into block; D, same; F, same.

Residue above 355°: B, of soft waxy nature and not less than 1.17 sp. gr. at 25°C; yellow amber color of spot by transmitted light when absorbed by white filter paper. C (above 315°) soft and easily indented by finger. D, soft and adhesive if more than 5%.

Loss by evaporation: B, not more than 5% in 72 hours at 49°C. in open tin box 2½-in. diameter, ¾-in. depth, 25 grams weight.

Waterproof, antiseptic: C, waterproof, antiseptic, at least 10% of crystallizable naphthalene and 15% of stable anthracene oil.

Sulphonation test: D, no oily residue insoluble in caustic alkalies when test is applied to fraction between 305° and 320°C.

Caustic soda test: D, creosote shall yield not less than 8% by volume of tar acids to a solution of caustic soda.

Specifications for Treating Blocks.

The following description of the method of treatment is from the Toronto specifications (D) and is similar to but slightly fuller than in the A. S. M. I. report (A). Where A differs from D, the provisions of A are given in parenthesis:

The blocks shall be placed in an approved retort in properly constructed cages and heated with live steam to a temperature of not less than 180°F. and not more than 240°F. (A, 220° to 240°) for a period of at least two hours. During this period the condensed steam, etc., shall be drained off at intervals and at the end the retort shall be blown out and the steam allowed to escape; then a vacuum of not less than 24 inches (A, 20 inches) shall be applied for 1½ hours (A, at least 10 minutes) and, after draining retort, a further vacuum for ½-hour (A, omitted) the temperature in the cylinder being maintained during vacuum at approximately 180°F. (A, blocks maintained at 150° to 240°). The cylinder shall then be filled with the specified oil at a temperature of not less than 180°F. nor more than 190°F. (A, 180° to 200°) without breaking vacuum, and pressure shall be applied and gradually raised during a period of 2½ hours or for a sufficiently longer period to insure that all blocks shall contain after treating an average of 14 pounds (A, 18 pounds) preservative as specified herein per cubic foot of wood. (A, supplemental vacuum with or without steam may be applied). During this period the temperature of the oil shall not be allowed to fall below 165°F., and on completion the free oil may be pumped from the cylinder.

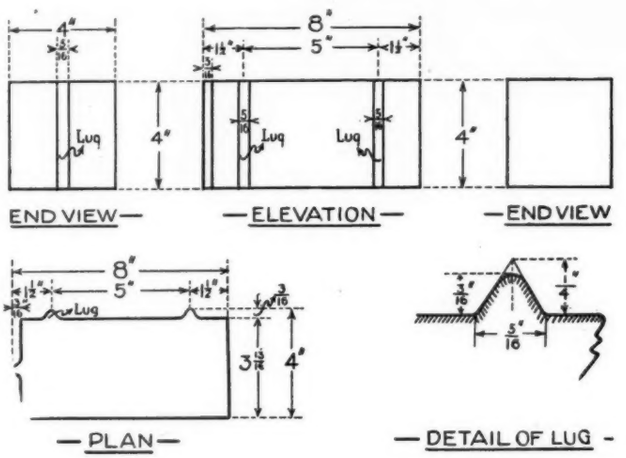
Upon completion of the treatment charges shall be allowed to remain in the cylinder from 30 minutes to 1 hour at temperature of 165°F. (A, omitted.)

(A, has additional: Not more than 10% excess over the 18-pound specified shall be allowed. The blocks after treatment shall show satisfactory penetration of the preservative, and in all cases the sap-wood must be thoroly treated thruout. To determine this, at least 25 blocks from each charge shall be cut up and if more than 4% of the blocks shows untreated sap-wood, the charge shall be re-treated or rejected. After re-treating, the charge shall be again subjected to the same inspection. The surface of the blocks after treatment shall be clean and free from any deposit of oil or foreign substance. All blocks that are imperfect or that have been injured in the process of treating shall be rejected.)

Handling Blocks After Treatment.

The committee of the A. S. M. I. considers the method of handling blocks from time of treatment to time of laying in the street of great importance and provides as follows:

After the blocks have been treated and before they are laid, care must be taken to protect them as much as possible from drying out. They must at all times be closely piled when stacked on the street. All blocks must be thoroly wet, either while piled on the street before laying or while being laid, as directed by the engineer.



Toronto received bids on two forms of blocks. One form is rectangular with depth, parallel to the fiber of 4 inches, width 3 inches and length 6 to 10 inches with variations of not more than $\frac{1}{16}$-inch in width or depth. The other form has two ribs or lugs on one long face, and one rib or lug on one end, in each case parallel to the fiber, as shown in the accompanying drawing. The depth of block is 4 inches, width 4 inches to outside of lug and length 8 inches to outside of lug, the ribs projecting $\frac{3}{16}$-inch from the body of the block. Variations in dimensions are permitted if not more than ⅛-inch in width or depth or more than $\frac{3}{16}$-inch in length.

Contract for these blocks was let at the following prices:

The committee of the A. S. M. I. recommends blocks of 3 to 4 inches width, all blocks used in the same city block to be of the same uniform width; 5 to 10 inches length, averaging 8 inches; and depths of 4 inches for heavy traffic streets, 3½ inches for medium to light traffic streets, and 3 inches for light traffic street, length of blocks in the last case to be not more than 8 inches.

A MODERN GRANITE PAVEMENT IN PHILADELPHIA.

EAST GRAND BOULEVARD, DETROIT, MICHIGAN, SHOWING ARTISTIC LAMPS AND LAMP POSTS AND THEIR EFFECTIVE DISTRIBUTION.

The Municipal Lighting Plant

OF DETROIT, MICHIGAN

SOME account of the lighting plant of Detroit, Mich., which gives the excellent results stated in the article on page 128 of the April number, will be of interest.

All of the electrical energy required for the operation of the Detroit Public Lighting Plant is generated in the main station at 40 East Atwater St. The current supply is 2-phase, 2,300-volt, 60-cycle.

2554 lamps are connected to the main station. The balance of the arc lighting service is from five substations. For the latter the potential is stepped up, at the main station, to 5,500 and 6,600 volts. There are also two transformer stations; one in Belle Isle Park, the other in Palmer Park.

For Belle Isle Park, a 3,600-volt, 3-phase feeder furnishes the power for the incandescent lighting and motors. In Palmer Park, the transformer station serves the incandescent lighting and 27 6.8-amp. series arc lamps. From four of the substations 2147 6.8-amp. series arc lamps are supplied, and from five of the substations 3007 4-amp. and 485 6.6-amp. luminous arcs are operated.

For the incandescent lighting and power required at those public buildings in the territory adjacent to the substations, the 5,500-volt potential is stepped down to 2,200, the same as that of the mains from the generating station.

From the main station and each of four of the substations, a patrolman with horse and buggy inspects those lamps located in his territory immediately after the arc circuits have been started, and also attends to any outside trouble that may develop during the evening.

The property controlled by the Public Lighting Commission now consists of the following:

Main Station.—The power house and office building, has a frontage on Atwater St. of 213 feet; 163 feet of which extends back an average of 318 feet 6 inches to the river front, and 50 feet of which on the east extends back only a distance on an average of 68 feet. At Atwater and Randolph Streets is a building for offices, storeroom and shops with frontage on Atwater St. of 80 feet, on Randolph St., 48.34 feet.

Five substation are located upon property owned by the city as follows: Thirty feet in the south side of Custar Ave., between Beaubien and St. Antoine Sts. Thirty feet in the south side of Newberry St., between Campbell and Junction Aves. Thirty feet in the west side of Beals Ave., between Mack and Goethe Aves.; Sixty feet in the west side of Lawton Ave., south of Warren Ave.; thirty feet, 171 feet deep, in the south side of Palmer Avenue, between McDougall and Elmwood Avenues. Upon the first three lots are brick buildings 30 ft. by 40 ft., with concrete floors. During the past year, fireproof additions have been built to these three substations, and the roofs over the old parts have been replaced by tile and concrete roofs, thus protecting the substations against the hazard of fire from adjacent buildings. The building in Custer Avenue is now 30 ft. by 116 ft. 3 in.; the one in Newberry Street 30 ft. by 102 ft. 7 in.; and the one in Beals Avenue 30 ft. by 81 ft. 10 in. The substation in Lawton Avenue is 36 ft. by 60 ft. 4 in.; and the one in Palmer Avenue 30 ft. by 104 ft. 4 in. These buildings are also fire-proof, with pressed brick fronts, cut stone trimmings and reinforced floor and roofs.

The pole yard for the west end of the city fronts for 372 feet upon Stone St. and is adjacent to the tracks of the Wabash R. R. For the east end of the city, the new yard fronts for 81.94 feet on Hart Ave. It is 316.75 feet deep, to the tracks of the Detroit Terminal R. R., upon which it adjoins for a distance of 193.09 feet.

The boiler house contains four 30-h. p. double-deck tubular boilers, C. C. Peck design, with Hawley down draft furnaces; one 300-h. p. Wickes vertical water tube boiler with Detroit stoker; three 400-h. p. Wickes vertical water tube boilers with Taylor stokers and Foster super-heaters; and two, Class O, No. 16, Sterling water tube boilers with Taylor stokers.

Coal for boilers with stokers is weighed and fed from an overhead steel bunker of 1,200 tons capacity. This bunker is filled from a Link-Belt conveyor in conjunction with coal crusher and conveyor from track hopper. Coal for the other boilers is handled in 1-ton charging cars on a Hunt industrial railway, from bins adjoining the firing floor. The capacity of these bins is 960 tons.

A side track, built by the Commission, in Atwater street, and connected with the railway tracks at Riopelle street, allows cars of coal to be placed alongside and unloaded directly into coal bins or a track hopper conveyor. The Commission has its own track scales and all contract coal is paid for on "out weights."

The Pump Rooms contain: One fire pump, capacity 1,000 gallons per minute; one 10x5x10-inch and one 14x8½x10-inch Worthington duplex boiler-feed pump; one 10x7x15-inch Platt duplex boiler-feed pump; one Worthington jet condenser that will condense 50,000 pounds of steam per hour, feed pump attached; two Alberger barometric condensers, each one con-

densing 50,000 pounds of steam per hour; one centrifugal pump connected to a 12x20x12-inch Westinghouse vertical compound engine; one 3,500-h. p. Cochrane receiver-type feed-water heater; two Westinghouse air compressors which supply air for cleaning apparatus; one Jeanesville 3-stage centrifugal pump connected to a Kerr turbine, with a capacity of 300 gallons per minute.

The engine room contains the following: One Westinghouse 5,000-k. w., 1,800-r. p. m., 60-cycle 2,300-volt two-phase turbine generator unit, connected to a Westinghouse surface condenser, which has a cooling surface of 8,000 sq. ft., condenser equipped with a Westinghouse-Leblanc air pump, an 8,000-gal. centrifugal circulating pump and a centrifugal condensate pump, circulating pump direct-connected to a 1,200-r. p. m. Westinghouse non-condensing steam turbine, Leblanc air pump and condensate pump mounted on same shaft and direct-connected to a 2,500-r. p. m. Westinghouse non-condensing steam turbine; two Westinghouse 2,000-k. w., 1,200-r. p. m., 2,300-volt 2-phase turbine generator units; two Alberger horizontal dry vacuum pumps, 12x22x18 inches; one triple-expansion marine-type engine, cylinders 17x27x46 inches in diameter, direct connected to a 600-k. w., 2-phase, 2,300-volt, alternating-current generator, developing 850 h. p. with 160 pounds steam

McGraw Avenue, east of Grand River Avenue, Detroit, Michigan, photograph taken at midnight, showing the efficiency of street lighting with ornamental lamps in amount and uniform distribution of light.

pressure and 26-inch vacuum at 120 r. p. m.; one three-line, triple expansion, center-valve, Willans engine, cylinders 13 7/16x20 7/16x32 inches in diameter, with 13 7/16 inches stroke, developing 800 h. p. with 160 pounds steam pressure, and 26 inches of vacuum at 277 r. p. m., direct-connected to a 600-k. w., 2-phase, 2,300-volt, Stanley alternator. Exciter units are one 60-k. w. Northern Electric 125-volt generator, direct-connected to a 100-h.p. center-valve Willans engine at 450 r. p. m; one 40-k.w. Northern Electric 125-volt generator, speed 325 r. p. m., direct-connected to a 100-h.p. Willans engine; one 60-k.w. Westinghouse 125-volt generator, direct-connected to a 100-h.p. Willans engine, speed 450 r. p. m.

In addition to the generators, the following alternating current apparatus is installed at the main station: Two 75-k.w. Western Electric step-up transformers; one 50-light G. E. mercury-rectifier arc-lighting regulator; thirty-nine 75-light G. E. mercury-rectifier arclighting regulators; five 350-k.w., oil-insulated, water-cooled, 2,200 to 5,500 transformers; three 750-k.v.a., oil-insulated, water-cooled, 2,200-volt, 2-phase, to 5,500-volt 3-phase transformers; six k.w., oil-insulated, water-cooled, 2,200-volt, 2-phase, to 6,600-volt, 3-phase, transformers; two 200-k.w., oil-insulated, self-cooling, 2,200-volt, 2-phase to 3,300-volt, 3-phase transformers; seven 150-k.w. 2,200 to 5,500-volt, oil-insulated, self-cooling transformers, three fitted up with regulating heads, in order that the voltage delivered may be regulated for any incandescent load operated from these transformers; two 50-k.w., 2,200-volt, 2-phase to 3,500-volt, 3-phase, oil-insulated, self-cooling transformers; one 100-k.w. 6,600-volt, 2-phase, induction-type feeder regulator for automatic operation; one 40-k.w., 2,200-volt, 2-phase, induction-type feeder regulator for automatic operation; one 33-k.w., 2,200-volt, single-phase, induction-type feeder regulator for automatic operation; one 45-k.w., 6,000-volt, single-phase, induction-type feeder regulator for automatic operation.

The apparatus at the substations consists, in addition to the switchboards, of: Thirty-five 60-light and fifteen 75-light inductance type arc circuit regulators; six 150-k.w. 5,500 to 2,200-volt transformers; three 150-k.w. 6,600 to 5,500-volt, oil-insulated, self-cooling transformers; four 30-k.w. 5,500 to 2,200-volt transformers; nine 75-k.w. 5,500 to 2,200-volt transformers; three 37½-k.w. 5,500-5,500-volt transformers, used to isolate an a. c. arc circuit, when in trouble, from the substation bus; fifty-four 4-amp. General Electric mercury-rectifier arc lighting regulators; eleven 6.6-amp. General Electric mercury-rectifier arc lighting regulators.

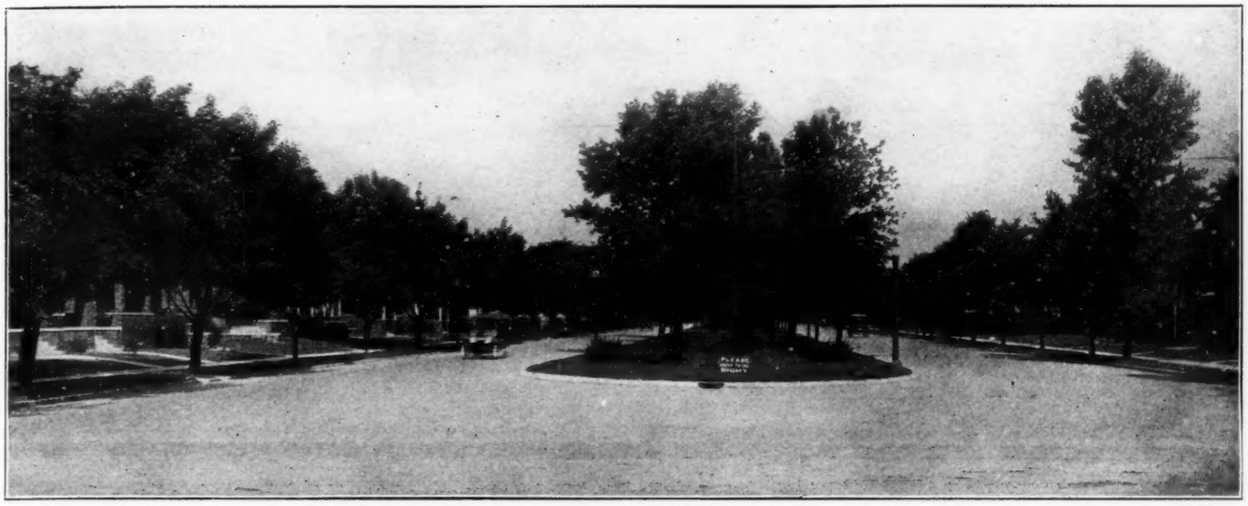
There are 1,566.11 miles of copper wire in the system, strung on 25,783 poles, of which 16,999 belong to the commission, 8,241 to the Edison Illuminating Company, 413 to the fire and police departments and the remainder to telephone, telegraph and street railway companies, who use in return the poles of the lighting system in about equal numbers, except that the fire and police departments use nearly 1,400 of the electric light poles.

There are 337,868.5 feet of electric conduits, of which 106,340 feet have two ducts, 101,560 have four ducts, 40,712 have seven ducts, 34,496 have nine ducts, and the remainder various numbers of ducts up to twenty-eight. There are also some 337,000 feet of single-duct laterals, about half 3½-inch vitrified clay tile laid in concrete, one-third 3-inch wood pump log, and the remainder 2½-inch iron pipe. The department uses 1,493 feet single-duct of Edison Illuminating Company's conduits, and they use 4,495 feet of the department conduits, including double and single ducts. The fire and police departments use some 7,000 feet of the electric light department conduits. Rental for use of conduits is charged at 5 cents a foot per annum for single duct, 9 cents for two parallel ducts and 12 cents for three.

The 700 acres of Belle Isle Park require two-thirds of the wooden conduit, all the park light wires being underground.

Detroit was one of the cities which installed tall steel frame towers for supporting groups of electric lights in the earlier days of electric lighting. When the public lighting plant was put in operation in 1895 there were 137 of these towers in use. The number has been reduced to 22 3-light and 21 4-light towers, which will ultimately disappear, the only high lights to remain permanently to be four on the standpipe in the water works park, which serve as a beacon to boats crossing the Detroit river.

As shown in last month's article, about 30 per cent of the street lamps now in use are single or double-light ornamental posts. One of the accompanying photographs shows the unobtrusive and decorative appearance of these lamps on East Grand boulevard, the posts shown being of the Broadway design, made by the Geo. Cutter Company, South Bend, Ind. Another photograph, which was actually taken just as shown, at midnight, shows the large volume of light supplied by the lamps and the even distribution of light due to the effective placing of the posts.



EAST GRAND BOULEVARD, DETROIT, MICHIGAN, A NOTABL E THOROFARE PAVED WITH SHEET ASPHALT LAID BY THE MUNICIPAL ASPHALT PLANT DEPARTMENT.

STREETS AND THE CITY BEAUTIFUL

By D. T. Pierce, Philadelphia, Pa.

A very large proportion of the area of every city is covered by streets, including pavements, sidewalks, lawns and park spaces. Their design and construction therefore, have a predominating influence upon the appearance of the city as well as upon its convenience of use of them. This article points out the lines to which attention must be paid and the physical and business as well as esthetic value of proper street design with some beautiful examples of proper treatment of the problem.

WATER supply, sewers, lighting, transportation and paved streets are, by common consent, the five essentials to the health, comfort and general welfare of a municipality. The progressive community, however, is seldom content with mere essentials or bare necessities. Having obtained a lighting system that will partially illuminate its thoroughfares, it in time demands ornamental lighting systems in place of a glaring arc light on a hideous pole. Having got pavements which keep the inhabitants out of the mud, it soon demands not merely passability, but beautification.

This development is rapidly progressing in American municipalities because no single phase of the city beautiful movement accomplishes so much in so short a time as does the building of attractive boulevards and streets. Given all else implied by the term, and a town without attractive streets would never reach the status of the city beautiful. The importance of this feature of municipal improvement is illustrated by the accompanying views of notable boulevards. The beautiful street is the framework of the whole city beautiful proposition.

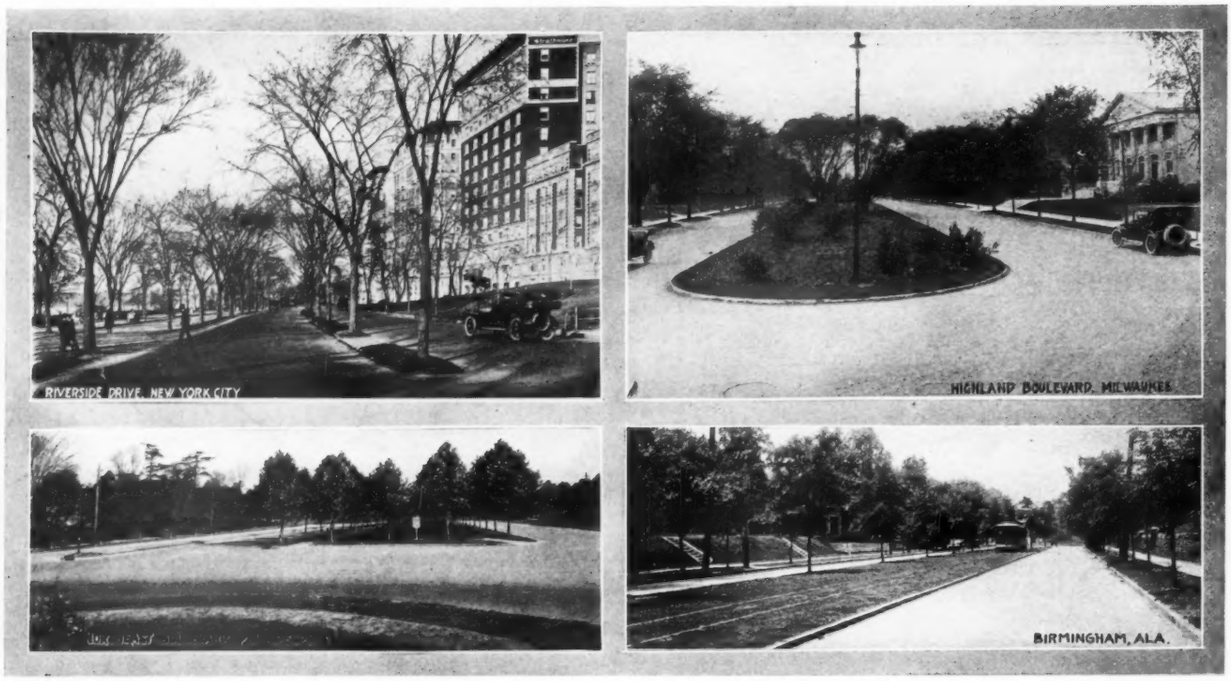
Some towns have gained distinction because of a single beautiful street, while others have established boulevard systems of world-wide celebrity. Whether one's first impression of a town is favorable or unfavorable is governed largely by the appearance of the streets.

Beautiful streets need not be restricted to large cities. Many quite small towns have been successful in utilizing very slender resources to the highest advantage. The photographs here reproduced of Main street, Marshall, Mich. (a town of 4,300 population), and Winterset, Ia. (with only 2,800 people), demonstrate that big cities have no monopoly of attractiveness, whatever they may claim as to mere size.

In the planning of city boulevards the best results are obtained by providing very wide streets. Aside from the attractive appearance of broad avenues, traffic is greatly facilitated by leaving room on each side for a large number of vehicles. A further advantage of the very wide boulevard is the fact that narrow parks or plots of grass may be established as the dividing line. Riverside Drive, New York City, is sufficiently wide to carry three thoroughfares divided by handsome trees. In the case of entirely new boulevards grass plots with shrubs and flowers can be obtained in a single season. Birmingham, Ala., has introduced a novel feature on Highland avenue by transforming the roadbed of a street railway into a grass plot.

From tasteful grouping of shrubs and trees some towns have given careful thought to harmony of color in the planting of flowers. Just what will happen when the futurist movement demands vivid and contrasting colors remains to be seen, but as we are governed largely by prevailing fashions, something gorgeous may be anticipated. However, the fact that every ornamental accessory increases cost of maintenance will have a tendency to preserve the more simple types of boulevards. Where fine old trees arch over the thoroughfare nothing better is required. Such streets are certainly more attractive than the over-ornate. Straining after unusual effects invites disaster. Frederick Law Olmstead's story of the transformation of a simple and charming old New England common into an "Italian garden" by a too ambitious village improvement association illustrates the point. Philadelphia had an esthetic brain-storm some years ago, and the debris is still there in the shape of bare and forlorn frame pergolas along dusty, sun-baked sidewalks. Many small towns having tree-shaded streets could transform them into beautiful avenues at little expense, a profitable thing to do in every sense of the word.

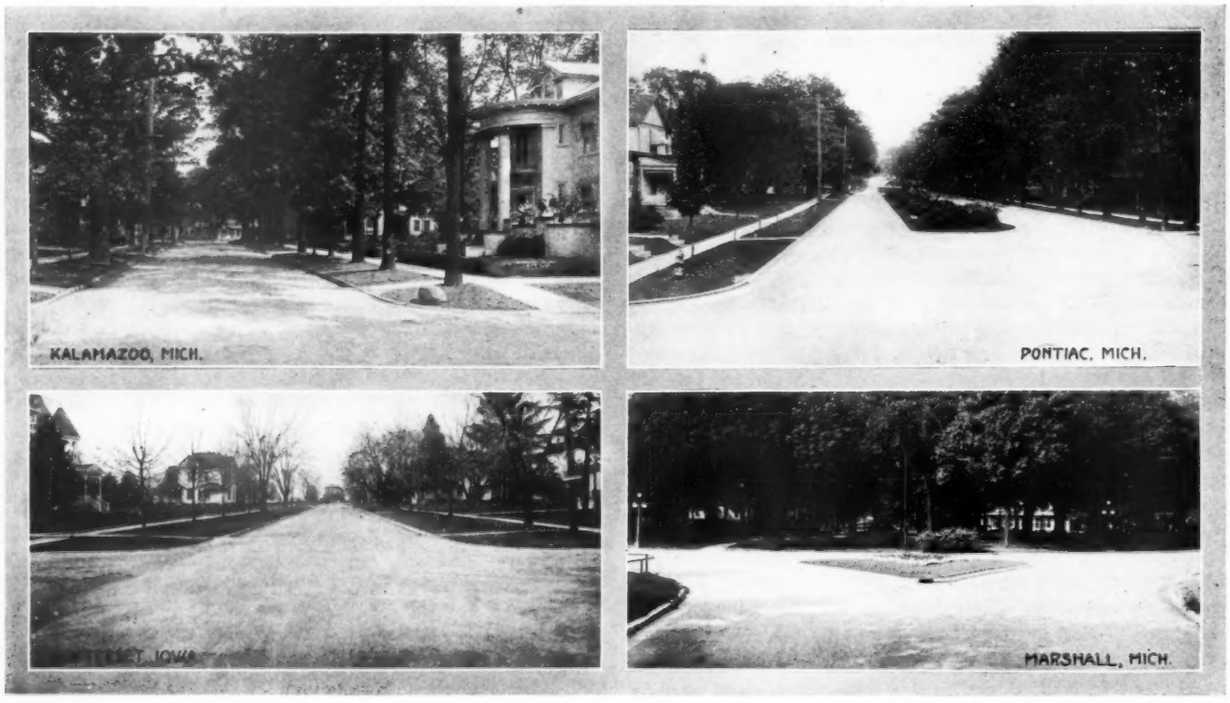
To obtain satisfactory results, modern requirements prescribe that boulevards shall combine utility with beauty. The two cannot be divorced. For example, many old towns have



beautiful streets, but streets entirely lacking from the standpoint of utility, economy and convenience. Few things are more picturesque than an old town or village street shaded by ancient trees. The very absence of curbs, the irregular grass-grown gutter embankments and winding pathways for pedestrians, emphasize their charm, just as the rudely cobbled and narrow streets of European towns appeal to us as beautiful and picturesque. But the price paid for beauty of this kind—the sacrifice of utility and sanitary requirements—is too great. Therefore the modern boulevard or street beautiful must be well paved, and at the same time in harmony with its environment. It must be free from mud and dust, possess minimum tractive resistance and have a surface sufficiently resilient to deaden noise and meet the requirements of both horse and motor traffic.

Perfection from this viewpoint is easily obtained thru the use of asphalt pavements. All of the handsome boulevards pictured here were constructed with natural asphalt, which meets a further requirement—something that will not show replacements in case it is necessary to take up or repair a section of street. The patched-looking street is always unsightly and objectionable.

The beautiful street is not a luxury, but absolutely essential to the successful development of the city beautiful.



WINTER OPERATION OF WATER WORKS

AT MILES CITY, MONTANA

By G. C. Pruett, City Engineer.

An interesting paper on the troubles found in the operation of a water plant, particularly as to meters and pipe lines, in a more than ordinarily severe winter in a cold climate, which contains many practical points for all water works superintendents.

MONTANA has just emerged from the severest winter of which there is any record in this part of the state. The extreme cold of 48 degrees below zero had never been reached but once since the establishment of a weather office in Miles City some thirty years ago, and the long continued extreme cold 45 consecutive days below zero as a minimum temperature had never been reached before. The cold weather started about the middle of December when we had considerable snow, with the temperature around zero, from then until the first of January. January and half of February were continuously below zero with a slight break from the 15th to the 25th of February, then more zero days to the 5th of March. All told we had 60 days below zero minimum temperature during the winter, most of which were from 15 degrees to 30 degrees below. During this time we had a great deal of snow, often snowing when the thermometer stood at 20 degrees below zero, which is very unusual for this section, where it seldom snows after the thermometer reaches zero.

We began having meter trouble on the 11th and 12th of January, when the thermometer reached 46 degrees below zero on the 11th and followed up on the 12th with 48 below. On those two days we removed 30 meters from basements frozen out of a total of 950 in service. These meters were all left out until the cold weather let up, replacing them with pieces of pipe cut to the exact length of the meter and connected between the meter connections. From the 12th of January to March 1st we removed 25 others, making a total of 55 meters removed on account of freeze ups, and 15 from other premises where there was danger of freezing. Fifty of these were replaced in three days by two men after the 1st of March. The balance being underground installations, were not installed until between March 25 and April 1, being replaced at the rate of five per day by the same two men.

The damage done to the meters was comparatively small; only one meter was completely ruined, six had their intermediate gears spoiled, eight had stems connecting from intermediate to register gears twisted off. The balance merely had the frost bottoms bursted or flanges sprung, all of which were easily repaired at a nominal expense. The total cost for labor, material and testing (all were tested before being replaced) amounted to a trifle less than $150, or, based on the total meters in service, 15.8 cents per meter.

Our service trouble started about February 1, and reached a maximum about February 15, gradually decreasing until March 10, since which time we have had no further trouble. All told we had 130 services frozen outside of basements during the winter, but inasmuch as several of these were frozen two or three times during that period, the actual number of services involved was a little less than 100, or approximately 10 per cent. of the total in use.

The principal places of trouble we found to be at the gooseneck and at the curb box, with several frozen at the gutter line.

While the city does not assume the responsibility of thawing or taking care of the service pipes, it being the duty of the individual consumer to lay and maintain the service from the main, we found it necessary last winter to take charge of the thawing on account of the plumbers not having proper equipment for doing the work. The frost was so deep and so hard that an attempt to expose the pipe by digging down to it meant considerable delay in re-establishing service. For that reason the city purchased the necessary equipment, which consisted of one 1,100 to 50-volt transformer, cable, meter, switches, choke coil, etc., and constructed an electric thawing apparatus. The whole equipment was placed on a trailer and pulled by a Ford roadster. In thawing, connection was made to the electric mains, the current stepped down to 50 volts and connections made to the house water system and the nearest fire hydrant. The amount of current was controlled by the choke coil and checked by an ammeter in the thawing circuit. For ¾-inch services the current was not allowed to exceed 150 amp., and at this rate a service which had not been frozen more than a day was thawed in about 20 or 30 minutes, altho we had some cases requiring one to three hours. With that amount of current it was also not possible to thaw frozen goosenecks. These were thawed by digging them up or by using a portable steam rig as described later.

The reason for limiting the current to 150 amp. was because by trial this was found to be the maximum which could be successfully used without danger of causing the pipe or gooseneck to burst. Heavier currents melted the wiping between the lead and brass or heated the pipe so quickly as to cause it to break. After a little experimenting we only broke one connection in about 100 thawed.

The charge made for thawing was $5.00 per hour or connection and $5.00 for each hour after the first, i. e., minimum charge was $5.00. This only covered the rent of the rig and three men to handle it, employes of the light department. In addition to this, the consumer was required to have a plumber to take care of any pipe work and look after leaks in case any should develop.

We also had some trouble with hydrants and mains. The first main froze on February 20, it being a long dead end with few consumers. The point where it froze was at a bend where a run-off had been graded in the street and the pipe left with about 4½-foot cover.

The freeze was limited to a section about 100 feet long and was thawed with a portable 8-h.p. steamer mounted on a sled. Holes were first driven down to the pipe about 20 feet apart, by means of 1-inch drills pounded down with a sledgehammer. Steam was shot into these holes until the frost was drawn and then the pipe was uncovered at these holes in sections of about 5 feet. Short pieces of pipe were then worked along the top of the water pipe and thoroly steamed from one hole to the next. The main was tapped to locate the frozen section and the steaming process continued from hole to hole until the main was opened. It did not break and gave no further trouble from freezing, altho the frost was below the main before it was steamed.

About the time this first section was opened two other sections froze the same day. One of these was also a dead end and the other a connected circuit where the street had been graded down until there was little more than a 4-foot cover on the pipe. This latter was a considerable stretch—about 400 feet. The first of these was thawed as described above. It was sufficiently deep, i. e., compared with other sections of town where we had no trouble, but the soil was a gravelly sand,

very porous, down from about 12 inches of the top. The top 12 inches was light loam. This material was not frozen hard—in fact, it could be spaded without picking after the first 2 feet—but handfuls of it around the pipe showed frost crystals. One joint of pipe was split.

The other freeze-up of these two was uncovered the whole distance. First, the section was valved off so as not to interfere with the service in the balance of the district, then the frost was drawn by means of steaming holes drilled 10 feet apart, as described above. Five split joints were found in this section, and, after being replaced, the whole pipe was lowered 18 inches. Only two joints in the 400 feet showed leakage from the lowering and they were only seepage leaks.

The cost for this work was as follows:

Labor—	
Steaming	$ 40.00
Cutting in two valves	18.50
Repairing main	13.00
Lowering main, uncovering and back-fill	120.00
Total labor	$191.50
Material	52.00
Total	$243.50

Labor, $3 per day for eight hours; foreman, $4.00 per day; team without driver, $3.00 per day. No rent charged for steamer or tools.

The only other place where we had trouble was on a street where the pipe had a 5½-foot cover and mostly loamy soil, which would not be expected to freeze so deep, but on account of the poor surface drainage we found good 6 feet of frost. This was the deepest frost found. We had no difficulty in steaming it out, and after replacing one split pipe in a run of 120 feet we had no further trouble.

The total cost of taking care of our 20 miles of mains on account of freezing was $650, or $32.50 per mile.

The fire hydrants presented a new problem to my experience. Heretofore our trouble has been limited to water freezing in the barrels, due to leaky valves and poor drainage. While we have not had a great deal of trouble in the past, what we did have could be traced to one of these causes.

Last winter we not only had these troubles to contend with, but also trouble with the connections freezing adjacent to the valves. During the winter we found only two hydrants frozen in the barrels and twenty frozen just outside of the valve, out of a total of 150. Some of these twenty froze more than once after being thawed.

The thawing was done with the portable steamer by hooking directly onto the nozzle with a cap tapped and connected with the steam hose. The hydrant was left closed to blow the steam, which was carried at 50 pounds for this work, out thru the drain opening. This not only warmed up the hydrant and pipe, but the ground around the hydrant also. It took about ten minutes per hydrant on an average. As soon as this trouble developed we went over all of them each week and steamed them whether they were frozen or not.

The cost for three general steamings and the special attention given to the bad ones cost $120 at the wages stated above, but not including boiler rent, or an average of 80 cents per hydrant.

It has been our practice to crate the bad hydrants each winter and pack them with dry straw manure. We have probably averaged crating fifteen each winter, but last winter this apparently did no good; besides, it froze so solid one needed a pick to get to the hydrant.

The frost last winter averaged about 2 feet deeper than we have had it before, probably accounted for by reason of the heavy soaking rains thruout the fall and early part of the winter. The ground went into the winter with more moisture than I have seen before, and notwithstanding the heavy covering of snow, the frost went down very easily. I am of the opinion that if the ground had been ordinarily dry when the snow fell we would not have had an unusual depth of frost.

ILLINOIS RUSHES HIGHWAY WORK

By S. E. Bradt, Secretary State Highway Department, State of Illinois.

That Illinois is determined to make up for lost time in the matter of highway improvement is apparent from the rapid development of public sentiment since the passage of the Tice law.

Ninety-two of the 102 counties accepted and used the 1913 and 1914 state allotments; 100 counties accepted the 1915 allotment.

There was expended under the direction of the state highway department to January 1, 1916, the following:

Appropriated by legislature in 1913 from general fund	$ 300,000
Appropriated by legislature in 1913 from auto license fees	800,000
Appropriated by counties	1,100,000
Total	$2,200,000

With the above there have been constructed approximately 150 miles of state aid roads, mostly concrete and brick, in seventy-two counties, and 811 concrete bridges and culverts in twenty-five counties.

There will be expended by June 30, 1917, in addition, the following:

Appropriated by legislature in 1915 from auto license fees	$2,000,000
Appropriated by counties	2,000,000
Total	$4,000,000

This, with the 1913 appropriations above referred to, makes a total of $6,200,000 to be expended from the regular state aid fund up to June 30, 1917.

It is estimated that there will be constructed by this department with the above fund from the beginning of work in July, 1914, to June 30, 1917, the following:

250 miles concrete at $12,000	$3,000,000
50 miles brick at $16,000	800,000
80 miles macadam or gravel at $6,000	480,000
Bridges	500,000
1,420 miles earth roads at $1,000	1,420,000
Maintenance	30,000
Total	$6,230,000

In addition to the above there will be expended during 1916 approximately $1,900,000 from county bond issues—$400,000 in Cook county and $1,500,000 in Vermilion county. Contracts in Vermilion county have been awarded. The above are portions of bonds voted in the two counties mentioned to the amount of $3,500,000.

MECHANICAL TAMPING

OF TRENCH BACKFILL

By C. W. Wilson, Superintendent Exchange Construction, Wisconsin Telephone Company, Milwaukee, Wis.

THE Wisconsin Telephone Company has never let any of its conduit work by contract, in view of the fact that we are not only very particular concerning the way in which our conduit is installed, but equally zealous in seeing to it that the work, at every stage, is not only properly done, but put thru in the quickest possible time.

In spite of the fact that we have developed a corps of experts on this class of work, we have substituted mechanical tampers for hand tamping, as our experience has proven that tamping machines, the same as concrete mixers, not only do the work more thoroly, but that it tends to speed up the entire job, as workmen are bound to quicken their pace in order to keep up with the machine.

Our experience has also proven that any soil which can be tamped by hand can be tamped by machine much more effectively and economically.

Tough Red Clay at Superior, Wis.

Our work at Superior, Wis., in connection with a large conduit installation, will form a basis on which we arrived at the foregoing conclusions.

On this job four miles of trench back-fill was tamped by hand and approximately 6,000 feet mechanically tamped. Bell tampers, 5 inches in diameter, were used by the workmen, while the head of the machine-tamping ram measured 9 by 12 inches. The average depth of trench was 3 feet, average width 18 inches. The material consisted of a red clay of exceedingly tough texture, which, when wet, was almost impossible to tamp by hand, but the tamper thoroly compacted it at an approximate saving of 6 cents per lineal foot over hand tamping.

The Board of Public Works of Superior, Wis., first insisted that we remove all the excavated material and refill the trench with sand. When we demonstrated to them the efficiency of the tamper, they allowed us to back-fill with the clay, thereby saving more than the price of the machine, including freight, in sand alone. The sand would have cost 80 cents per yard delivered on the job, with an additional cost of 75 cents per yard for removing the excavated material—total cost of $1.55 per yard.

Costs of Both Hand and Machine Methods.

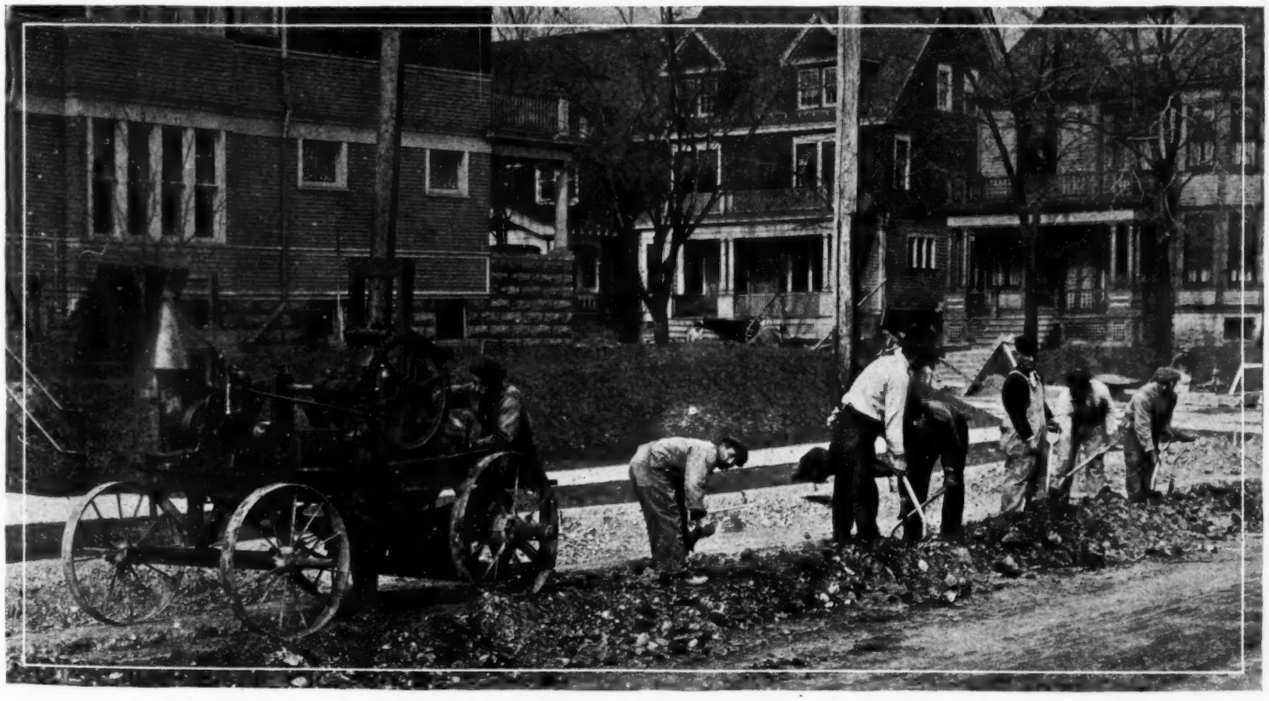
The machine referred to is a Pawling & Harnischfeger power traction tamper, equipped with a 3-h.p. 4-cycle engine. On this job accurate cost records were kept, so as to determine the actual dollars and cents difference between the two methods. The conditions under which the hand tampers competed with the machine were identical.

On Ogden avenue, between Twenty-first and Twenty-second streets, a distance of 464 feet, the actual cost of tamping was $9.13, or 1.9 cents per linear foot, with the power tamper. Another section on Ogden avenue, between Nineteenth and Twentieth streets, a distance of 417 feet, cost $5.06, or 1.2 cents per linear foot, with the power tamper.

In the alley north of Belknap street, between Banks and Tower avenue, a distance of 322 feet, the trench was tamped by hand entirely, at a cost of $23.80, or 7.3 cents per foot. In the same alley, between Banks and Oaks avenues, a distance of 345 feet, the cost of tamping by hand was $25.53, or 7.4 cents per linear foot.

In the alley north of Banks, between Hewitt and John and

P. & H. POWER TRACTION TAMPER, AS OPERATED BY THE WISCONSIN TELEPHONE COMPANY. ON SYCAMORE STREET, MILWAUKEE, THIS MACHINE KEEPS 6 TO 8 SHOVELLERS BUSY AND DOES THE WORK OF EIGHTEEN HAND TAMPERS.



SHOWING MACHINE TAMPING SURFACE FILL. NOTE COMPACTING EFFECT OF TAMPER HEAD.

Fourteenth and Fifteenth streets, a distance of 358 feet, a trench was back-filled and tamped partly by machine and partly by hand, at a cost of $19.85, or 5.5 cents per linear foot.

On Ogden avenue, between Fifteenth and Sixteenth streets, a distance of 466 feet, tamping by machine cost $16.90, or 3.6 cents per linear foot. This high cost was due to the fact that the excavated material had been rained on and made it more difficult to shovel.

On Ogden avenue, between Eighteenth and Nineteenth streets, length of trench 427 feet, back-filling and machine tamping cost $8.88, or 2 cents per linear foot.

On Cummings avenue, between Harrison and Seventeenth streets, a distance of 320 feet, back-filling and hand tamping cost $24.80, or approximately 7.5 cents per linear foot.

On Cummings avenue, between Seventeenth and Eighteenth streets, a distance of 320 feet, hand tamping cost $29.80, or 9.3 cents per linear foot.

Method of Filling and Tamping.

In back-filling trenches for telephone conduit, the method used by water, gas and sewer contractors cannot be used; in other words, the dirt must be put back dry, owing to the fact that the trenches cannot be flushed or puddled, for the reason that they are filled immediately after the concrete has been placed on top and bottom of the conduit, and any flushing of the trench would tend to wash the cement out of the concrete and make it worthless.

Our method of refilling the trenches, in connection with the use of the power tamper, is to place a layer of loose dirt about 8 inches deep on the top of the concrete before it has had its initial set. The power tamper, in passing over this, will compact it to about 4 inches in thickness.

Immediately behind the tamper follow six to eight shovelers, putting in another layer of loose dirt of about 8 to 10 inches in thickness. When the tamper has reached the end of the trench it is reversed and travels right back over the same ground and the shovelers pass to the other side of the tamper and follow until the trench is completely filled, including the replacing of the surface material, such as crushed stone or gravel, as the case may be, on macadam or dirt pavements. On streets with a concrete foundation, this filling process is followed to the base of the concrete foundation, after which the concrete is placed to complete the foundation for the pavement.

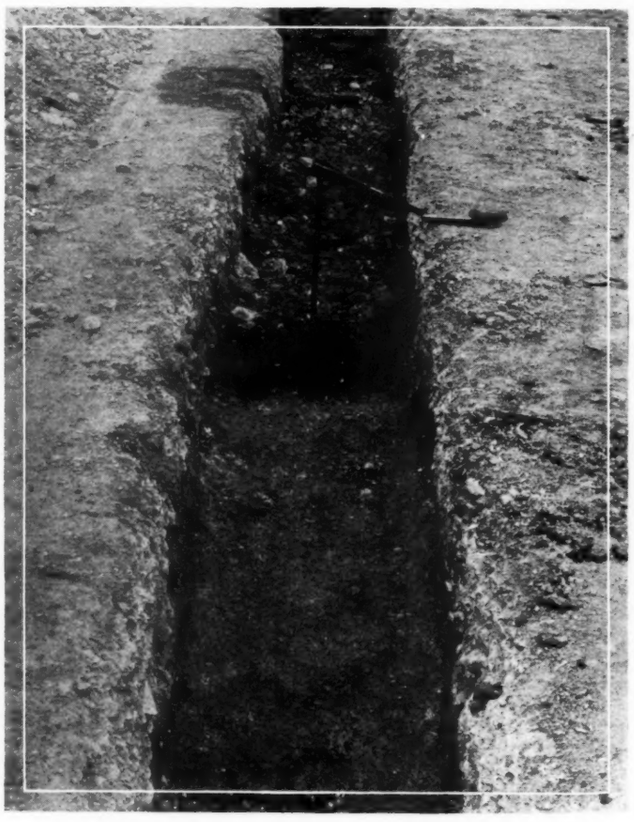
Machine Operation.

The machine, while tamping, travels at the rate of approximately 9 feet per minute, or 540 feet per hour. Our experience as developed with the machine is that it keeps six to eight shovelers busy, depending on the nature of the soil, and there is considerable satisfaction in knowing that after the machine has gone over the trench it is properly and thoroly compacted.

In order to accomplish the same result by hand as obtained by machine, it would be necessary to use eighteen tampers with the six shovelers, at a cost of 25 cents per hour, or a total cost of $8 per hour; whereas with the machine the cost for labor, not figuring the cost of the operator, $1.50 per hour, effects a saving of $6.50 per hour.

We are now using the machine on an installation of 3,600 feet of conduit on Sycamore street, Milwaukee, and at the same time we have two other crews in other parts of the city, the foremen of which are both clamoring for a machine on their jobs. We have, therefore, just placed an order for two more machines. We have used this machine very successfully in cutting asphalt and breaking concrete. In order to do this the machine must be equipped with a special ram, also fur-

SHOWING STRIP TAMPED BY MACHINE TRAVELLING AT RATE OF 9 FEET PER MINUTE.

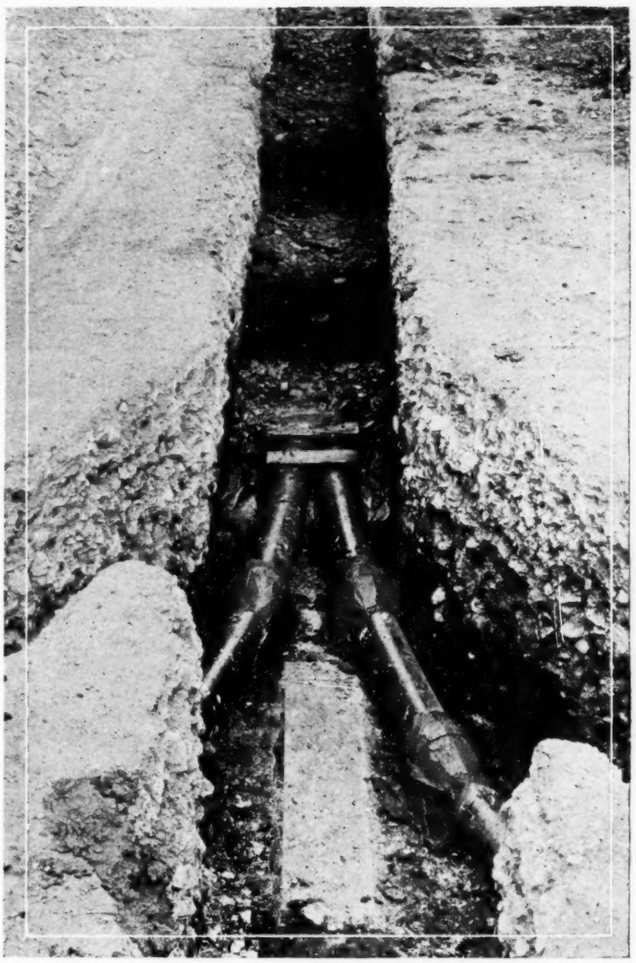


nished by the manufacturer, which takes a spud for breaking concrete or a knife for cutting asphalt.

We found that the best method to follow in cutting asphalt was to mark out the square to be removed with blue crayon, and then to move the machine down one side of the trench, following the chalk line, and reverse same and come back on the other side. We were able to cut entirely thru the asphalt to the concrete base about 60 linear feet per hour, both sides of trench.

Tamping Ram and Head.

The 150-pound ram drops approximately 26 inches about 42 times every minute, and the machine travels forward at a definite rate, so that a perfectly solid, uniform base is formed, which will support the pavement. This ram on its carriage is supported by two 6-inch rollers and moves across the machine on a steel runway. The standard tamping head is 9 by 12 inches, and has a maximum cross-travel of 16 inches, thus enabling it to actually cover 27 inches of trench. The tamping head is fastened into the bar of the ram by means of heavy bolts placed thru the lugs on the head, and is operated by means of a segmental pulley, brought in friction contact with the hardwood ram, by spring pressure on a large pulley on the opposite side of the ram. This segment is caused to revolve approximately 42 times per minute, causing a stroke of the ram at each revolution. This stroke has an average of 26 inches travel, and, as the ram and tamping head together weigh 150 pounds, a thoro packing of the earth results. A good laborer, with a 15-pound ram, will not average more than



SHOWING CONDUIT JOINT PROTECTION, CONCRETE MASS AND TWO LAYERS OF BACK-FILL MECHANICALLY TAMPED.

SHOWING EFFECT OF ONE BLOW OF TAMPING HEAD ON BLUE CLAY BACK-FILL.

20 strokes a minute, and with a heavier ram the number is even less. The laborer will hardly ever lift the ram more than 9 or 10 inches. Compare this with the machine's 150-pound ram, 26-inch stroke, 42 times per minute, and "do it all the time.

Human muscle, or man-power, is not always applied to a hand tamp. Even in the case of the conscientious workman the limit of endurance is soon reached and the hand tamp is merely raised to be permitted to drop of its own weight. As such feeble blows lack the necessary punch, the surface of the back-fill is merely smoothed over; it is not thoroly compacted or tamped.

While the tremendous savings in labor costs are no mean item, the assurance of work well and properly done should not be overlooked. Mechanical tamping also effects a great saving in worry and accounting.

The speedy completion of every job is also greatly appreciated by the taxpayers and the municipality, as the streets are again soon opened to traffic.

From our standpoint there is also the assurance that we will be minus complaints caused by the settling of pavements.

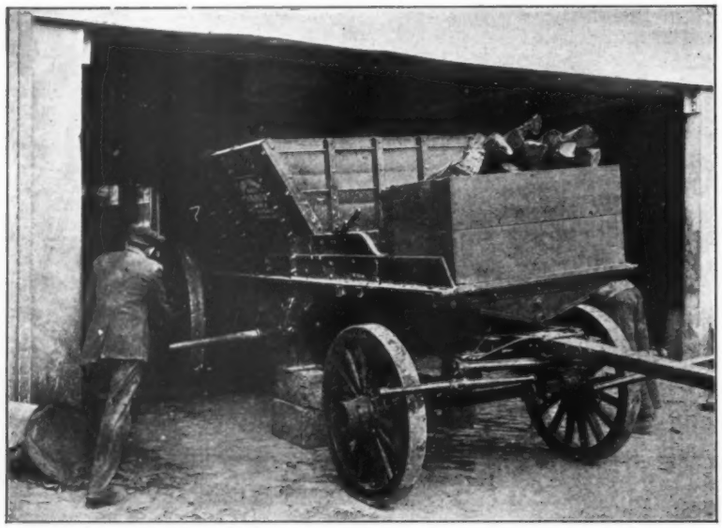
As each machine takes the place of eighteen hand tampers, we have just that many less men to strike, take sick, loaf on the job or lay off. There are no stalling or wasteful delays caused by hand tampers waiting for the shovelers to catch up. There is no watchful waiting, as the power traction tamper speeds up the work; shovelers (no time to light pipes) work continuously in order to keep up with the tamping machine.

MUNICIPAL ASPHALT PLANT

OF MANHATTAN BORO, NEW YORK CITY.

THE municipal asphalt plant of Manhattan boro, New York City, will complete its second year of operation on May 25, and has demonstrated its value beyond question. The construction of a plant has been advocated for some fifteen years, but it was not until 1912 that authority to build and operate it could be obtained, based on a detailed report by E. P. Goodrich, then consulting engineer of the boro, to the boro president. The plant was begun in March, 1913, and completed and put into operation on May 25, 1914.

The plant is located in the East river, between 90th and 91st streets, and running back to Avenue A, with dock facilities for unloading material. This location is so central that the maximum haul to any point in the boro is but 7½ miles.



VIEW SHOWS 120 CUBIC FOOT TRAILER BENEATH MIXER. ILLUSTRATING METHO OF JACKING UP FROM EXTRA SET OF WHEELS SO THAT TRACTOR CAN BE PLACED UNDERNEATH.

A Meade-Morrison hoist with 40-foot grab-bucket lifts material from barges and discharges it into a steel-lined hopper on a tower over three tracks running to sand, stone, and coal storage buildings. The hopper discharges into dump cars on these tracks, which run over the trestles to the respective buildings and dump into them thru openings in the roof. Spiral conveyors carry sand and stone from storage to bucket elevators, which dump directly into any one of these dryers.

The rotary dryers are 24 feet long by 5½ feet in diameter, may be operated independently and are used two for sand and one for stone. Capacity of each is 15 tons of sand per hour from 50 degrees to 400 degrees F. The forced draft operates opposite to the flow of the materials thru the drums and the temperature of the outflowing sand or stone can be regulated exactly by watching pyrometers placed where the fireman for the three furnaces can see them. The heated material is carried by bucket elevators to the top of the building to a 660-cubic-foot capacity sand bin and a 450-cubic-foot stone bin, the sand passing thru a 10-mesh screen on the way. The rejected sand is conveyed to the bottom of the stone elevator for use in the binder. Weighing boxes at the outlets of the bins discharge the exact amounts required for the mixtures. The limestone dust bin is filled by cars elevated on the platform elevator noted below. A spiral conveyor under the bin discharges the dust tdirectly into the weighing boxes.

There are four 40-ton asphalt melting kettles, each heated by 250 square feet of 1¼-inch diameter steam pipes. Each kettle is fitted with pipes for agitation of the melted asphalt by air or by dry steam at the 110-pound pressure necessary to heat it to 310 degrees. The asphaltic cement is chopped in pieces as it comes from the barrels and put in small hand cars, which are raised to the kettles on a platform elevator and emptied into the kettles as required. The fluxing oil tank of 25,000 gallons capacity is filled by a pipe, 150 feet long, running to the water front, where it can be pumped from the delivery tanks. Coils in the bottom of the tank heat the oil, which is automatically pumped to a weighing tank on movable track running on top of the asphalt kettle. The asphaltic cement is piped from the melting kettles in steam jacketed pipes to the weighting 2buckets hung on a trolley from which they can be emptied into either mixer.

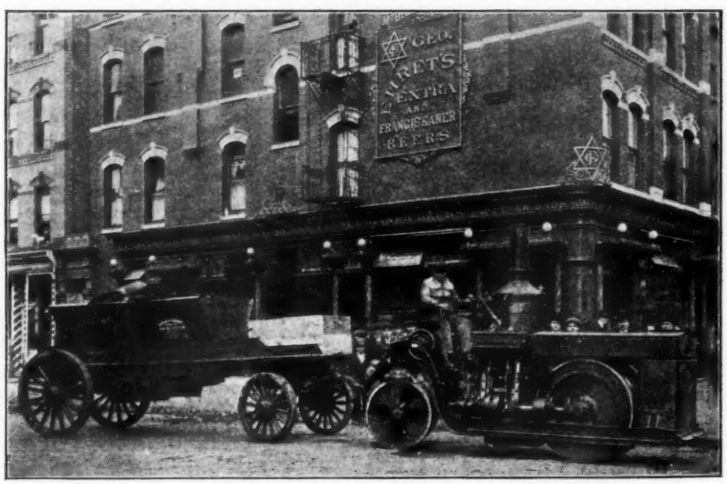
There are two Iroquois 16-cubic-foot mixers with tips bolted to the blades so that the tips only need to be removed for renewals. The mixers are jacketed with 40-pound steam.

Two 150-h.p. boilers and a 150-h.p. Corliss engine operate the plant with air compressor for agitating asphalt kettles, pump for elevating flux oil to weighing bucket and several pieces of apparatus for the machine shop adjacent.

Gases and dust from the dryers flow thru a horizontal steel flue to a dust washing chamber supplied with water in sheets thru which the gases pass and lose nearly all their dust.

The garage has, besides the department autos, six Saurer tractors, 37-h.p., 4-cylinder 4-cycle, with fifteen trailers, each 120-cubic-foot capacity, to haul material to the street. The trailers can be detached at plant or on the street and set on an extra set of wheels, so as to be hauled by the street roller.

The street equipment includes enough for twelve street gangs, including five Good Roads Machinery Co., and seven Kelly-Springfield asphalt steam road rollers for rolling asphalt



VIEW SHOWING FIVE-TON ROAD ROLLER HAULING 120-CUBIC-FOOT TRAILER FROM PATCH TO PATCH ON ASPHALT REPAIR WORK.

and hauling 8-ton trailers around on the street; and for each gang, 5-ton steam roller, tool wagon, canvas cover for tools and full complement of nineteen kinds of tools, barricades, signs, lanterns, etc.

The capacity of the plant was stated to be 3,000 square yards of pavement in eight hours. On one day in July, with only two of the three drums in use, 4,500 cubic feet were turned out in eight hours, eleven gangs laying 2,600 square yards of pavement. The 4,500 cubic feet would lay 2,000 square yards of 3-inch asphalt, or 3,000 square yards of 2-inch asphalt.

In the main office of the Bureau of Highways is a map upon which is recorded the condition of each and every street in Manhattan boro. This information is shown by different symbols and is taken from reports furnished by the district inspectors, who make periodic reports regarding the amount of wear and tear and openings in the streets.

The superintendent and gang supervisors get their information from this map and thus lay out the work for the street foremen.

In order to make possible the delivery of material on time, five gangs start work at 7:00 a. m., five gangs at 8:30 a. m., and two at 9:00 a. m. In this way, the tractors get a load to the 7:00 a. m. gangs before 8:00 a. m. and are back to have a load to the 8:30 a. m. gangs before 9:30 a. m.

In company with the gang supervisor where possible, the foreman marks out the patches to be cut out and repaired. For the first hour, the whole gang goes cutting out, the dirt truck is on hand and the old asphalt is shoveled into it and taken to a department of street cleaning dump. There is enough cut out for nearly half a day when the hot material arrives. Two men shovel material out of the trailer, then two small gangs of one raker, one tamper, one smoother and two wheelbarrow men start placing material in the patches.

The roller engineer reports one hour later than the rest of the gang and is ready to roll the patches when placed. When the days' work is done, the patches are accurately measured and located by the foreman. This is sent to the plant office with the time record of his men. The roller engineer is the last man off the work and sees that everything is in shape.

When on burner work the organization is different. With the ordinary surface heaters, there being no cutting to do, these men handle the burners; one man to each. This man also rakes the material away. From one to five burners are used at a time. Usually burner work has been from curb to curb, three to five burners being used.

LAYING TOPPING BEHIND LUTZ SURFACE HEATERS, 1,200 SQUARE YARDS LAID IN AN EIGHT-HOUR DAY.

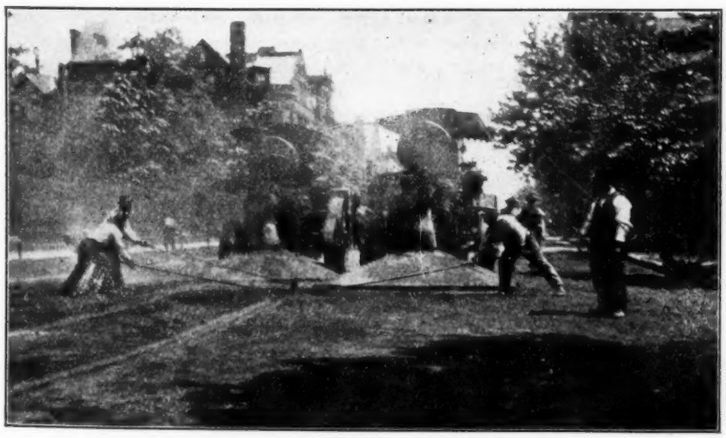
On West End avenue, from 72nd to 74th street, the Lutz surface heaters were used and easily burned over 1,000 square yards in eight hours. These blocks were resurfaced in first-class shape at the rate of one a day.

The summaries of cost show an average cost per yard for the season of 90 cents. There was a progressive reduction in cost each month, from $1.02 in March to 78 cents in July. For the month of June, during which cost per square yard averaged square yard for plant operations, including material for mixtures, direct labor and overhead, varied from 33.54 cents for work done for the department of water supply, gas and electricity, to 37.67 cents for repair of cave-ins, both very small 80.62 cents, details are given in full, and the average cost per percentages of the whole work done. Straight cutting and replacing with asphalt comprised 48.5 per cent. of the whole work done and plant operations cost 35.995 cents per square yard. Burner work comprised 39 per cent. of the work and plant operations cost 36.01 cents per square yard. Street operations cost 44.66 cents per square yard for straight cutting and burner work cost 44.657 cents. The total cost of straight cutting was therefore 80.655 cents per square yard, and of burner work, 80.667 cents.

The yardage of the month, 39,560 square yards, includes 1,509.6 square yards of stone foundations relaid, and as this work averaged 80.94 cents a square yard, it affected the total average very little.

Of the 6,500,000 square yards of sheet and block asphalt in the boro about 3,000,000 square yards of sheet asphalt and 1,000,000 square yards of asphalt blocks are kept in repair by the municipal plant. In this work 283,144.8 square yards of asphalt were laid at a cost estimated at $1 a square yard, when depreciation, interest, etc., are added to the 90 cents above, which latter includes other overhead charges.

The motor equipment is reported to show a saving of at least $60.00 a day over horse-drawn vehicles. It would take twenty-four horse-drawn wagons, at $7.00, to supply twelve gangs, or $168.00 a day, as against six tractors, at $18.00, or $108.00, this figure including repairs, interest, depreciation, etc., and may be even less when accurate figures are obtained.



USING TWO LUTZ SURFACE HEATERS ON WEST END AVENUE TO DETERMINE THEIR ADVANTAGE OVER SMALL HAND BURNERS.

WORKERS IN THE FIELD

Street Paving in Champaign, Illinois

The Editor of MUNICIPAL ENGINEERING:

Sir—Many improvements have taken place in paving construction as well as in the machinery and methods in use thirty years ago. One of the first improvements that came was the use of the roller, which I had cut out of solid stone by a mason, and used to roll the subgrade. At about the same time I secured an 1,800-pound iron hand roller for rolling the brick. This was a big improvement over hand tamping, and

A FLEET OF BAKER-MANEY SCRAPERS

was in general use until the horse roller made its appearance. Slip scrapers next gave way to two-wheel scrapers which made a big saving over loading dirt by hand.

We used to mix concrete by hand on wood boards. We considered we had made a big improvement when we adopted sheet steel mixing pans. The first power mixer was brought in about 1905, and while it was too large, at first, for use in narrow streets and was looked upon as a freak, it soon replaced human muscle methods.

About five years ago gravity carriers came in and we now run the brick from cars to wagons and from the wagons to the setters.

USING A GRAVITY BRICK CARRIER.

At present our rough grading is done with Maney four-wheeled scrapers which are loaded with tractor engine. The rolling of subgrade is done with a 10-ton steam roller and the concrete is mixed with a batch mixer which delivers it thru a chute to the spot wanted in the street.

Nearly all streets laid in Champaign in the last few years have combined concrete curb and gutter laid in 7-foot sections and hand finished. On the concrete base is placed 1½ inches of sand cushion, which is struck off with a Roughen adjustable paving gage running on the gutters. On this are laid the regular paving block and, after the culls have been removed, they are thoroly rolled, inspected again and any broken brick removed. The street is then rolled the last time and the filler is then placed.

Altho brick pavements are built better all the time, there has been very little increase in the price per yard to the city in thirty years, in spite of the fact that the cost of labor has nearly doubled in that time. This has been made possible only by the contractor using the most advanced improvements in equipment and constantly watching his work for a chance to improve.

It seems, unfortunately, to be the rule for the city to ap-

MIXING THE FOUNDATION.

PROUD OF THEIR WORK.

point as an inspector some man to whom the city fathers want to give a job without any special regard to his qualifications for the work, so that the inspector instead of being one whom the contractors can look to for help in getting the best possible job, often hinders the contractor, for altho his intentions are good, he simply does not know proper construction.

Thirty years ago all our work in Champaign was paid for by vouchers in five years' time. The city issued five separate vouchers against each piece of property assessed, one of which was due each year for five years with interest. It can be seen that in paying in this way on an improvement of any size, the contractor received about a ton of paper.

Now the city issues special assessment bonds due in from one to ten years, bearing 5 per cent. interest, which makes it very much easier to handle.

J. W. STIPES, Contractor,
Champaign, Ill.

Contract for Current for Street Lighting Criticized

The Editor of MUNICIPAL ENGINEERING:

Sir—I see by the *Electrical World* that the Ft. Wayne and Northern Indiana Traction Company has made a proposition to the city of Ft. Wayne, for furnishing electrical energy for the operation of the city's street lights. The city of Ft. Wayne does not furnish electrical energy for light and power purposes other than street lighting, as I understand it.

This, of course, is a mistake, because the city can do its best only when it furnishes electrical energy for all purposes. The same organization, the same poles, will carry the equipment for both purposes and naturally cut down the overhead expense and increase the efficiency of the system. This is the thing the city ought to do rather than lease its system or turn it over to the power company. The power company, of course, is afraid that the city will ultimately do this and they are consequently making them a seemingly low rate for their street lighting. They can, of course, make them a low rate for street lighting, sacrifice on street lighting and take it out of the private consumer. This is exactly what they are going to do if they are successful in this proposition. Somebody ought to protest and protest so loudly that the whole community can be educated on this matter and taught to see their interests in this whole proposition. Otherwise, this proposition may go thru and the city for ten years will have a contract on its hands which will rob them of the real success of municipal ownership of this electric utility.

SUPERINTENDENT OF MUNICIPAL LIGHTING PLANT.

Commission on Building Districts Submits Tentative Report to Board of Estimate of Greater New York

The commission on building districts and restrictions has transmitted to the board of estimate a tentative report presenting plans for the districting of the five boros of New York City. The plans provide for residential, business and industrial districts and for the limitation of the height of buildings and the area of the lot that may be covered. The commission will now hold a series of public hearings on the tentative report and plans and later submit a final report, which, if approved by the board of estimate, will definitely establish the proposed plan.

This will constitute the most important step yet taken by any American city toward the direction of the building of the city in accord with a well-considered plan. It will stop haphazard, heterogeneous development and substitute a commonsense plan of building control.

The commission has taken up the work begun by the heights of buildings commission appointed by the board of estimate in 1913. Following the report of that commission in 1914, the necessary legislation was promptly secured and the present commission appointed by the board of estimate to work out and recommend a comprehensive districting plan. Edward M. Bassett, formerly chairman of the heights of buildings commission, is now chairman of the districting commission. Its membership contains leading representatives of the real estate, lending and civic interests of the city. Walter Stabler, comptroller of the Metropolitan Life Insurance Company, has been very active in the commission's work, serving as chairman of the Manhattan sub-committee. The commission's secretary, Robert H. Whitten, and consultant, George B. Ford, have had charge of the expert work in the elaboration of the tentative plans. Herbert S. Swan has served as investigator, John P. Fox as transit expert and George W. Tuttle and Edward M. Law as engineers.

The commission says that "the bigger a city grows, the more essential a plan becomes. Traffic problems, the congestion of population, the necessity for an intensive use of land, the magnitude of property values affected, make the control of building development more and more essential to the health, comfort and welfare of the city and its inhabitants. New York City has certainly reached a point beyond which continued unplanned city growth cannot take place without courting social and economic disaster. Thru haphazard construction and invasion by inappropriate uses, the capital values of large areas have been greatly impaired. This destruction of capital value not only in the central commercial and industrial center of Manhattan, but also thruout the residential sections of the five boros, has reached huge proportions. It does not stop with the owners in the areas immediately affected, but is reflected in depressed values thruout the city. Market value for investment purposes is always affected by the hazard of the business. Whatever the capitalized amount that may properly be charged to the economic depreciation hazard, it is certainly a huge burden and one that affects not only the individual owners of real estate thruout the city, but the savings and other large lending institutions, the municipal finances and the general welfare and prosperity of the whole city. Permanence and stability can only be secured by a far-sighted building plan that will harmonize the private interests of owners and the health, safety and convenience of the public."

The merchants themselves are taking a first step toward districting the city, having devised a plan whereby, thru their own concerted action, they can move out and keep out of the finest shopping hotel and theater district of Manhattan boro, the manufacturers who have begun to establish themselves in the various buildings in that district which can be adapted to their uses.

The New York City Bond Sale

The successful sale of $55,000,000 4¼ per cent. bonds by the city of New York last month on an average of 4.10 per cent. is the strongest kind of evidence of the growing popularity of the income-tax exempt municipal bond.

In spite of the crisis in our foreign relations that was reached practically a few minutes prior to the public sale of the bonds, a number of powerful banking syndicates and dozens of the city's most prominent investment concerns, submitted flattering offers for the issue, oversubscribing the amount for sale about three and a half times.

The New York City sale is a reliable indication of the ease of the American money market and its results this time show very plainly, first, that there is a vast amount of capital seeking investment; and second, that the municipal bond, yielding less than 4¼ percent., but free from present and future federal income taxation, is coming to be the careful investor's favorite investment security.—*The Daily Bond Buyer of New York.*

FIRE DEPARTMENT

CHIEF HUGO R. DELFS, FIRE DEPARTMENT, CITY OF LANSING, MICH.

Did Lansing Buy First Pumper?

Chief Hugo R. Delfs, fire department, city of Lansing, Mich., reports but three horses in active service; two being used on an antiquated hook and ladder truck, while the other "continues to eat" except when called out by the fire alarm telegraph department, all of which is but an emphatic way of stating that the Lansing fire department is almost completely motorized.

We are illustrating Lansing's first motor pumper, which, in the language of Chief Delfs, is the first auto fire engine, built on order in America. It was delivered to us from the Webb Auto Fire Apparatus Company in the fore part of December, 1908, and placed in service December 16, 1908, and has been in continuous service ever since.

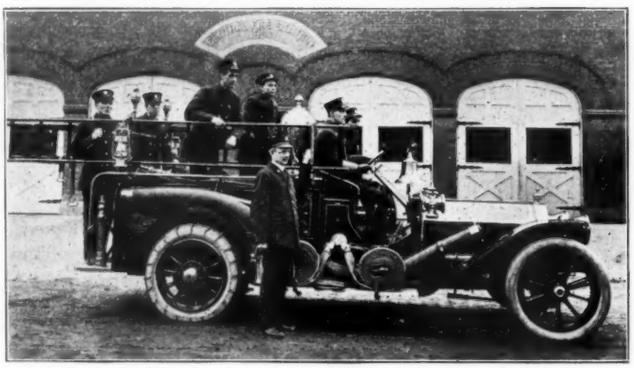
Has Lansing the Honor?

"Perhaps it would not come amiss to tell how we came by this auto fire engine. One certain spring, we had our usual election—taxpayers voting on a new high school, convention hall, two steam fire engines, etc. In fact, there was so much to vote on that the taxpayers went out and killed the whole business. A month or two after a newspaper clipping was sent to me by the late Judge Hooker, of the Supreme Court of Michigan. This clipping told of a remarkable automobile pumping engine, built by one A. C. Webb, a former auto racing driver. I became much interested and immediately got in correspondence with Mr. Webb. In a few weeks after that, Mr. Webb sent his demonstrating machine here to Lansing, and in less than three months he received an order for one of his auto pumping engines, the motor being supplied by the Olds Motor Works, of this city. The Webb demonstrator was rebuilt about the same time we ordered ours and sold to Joplin, Mo. It may be possible that Joplin had her engine in service a month or so before we had ours, but am not quite certain about this point.

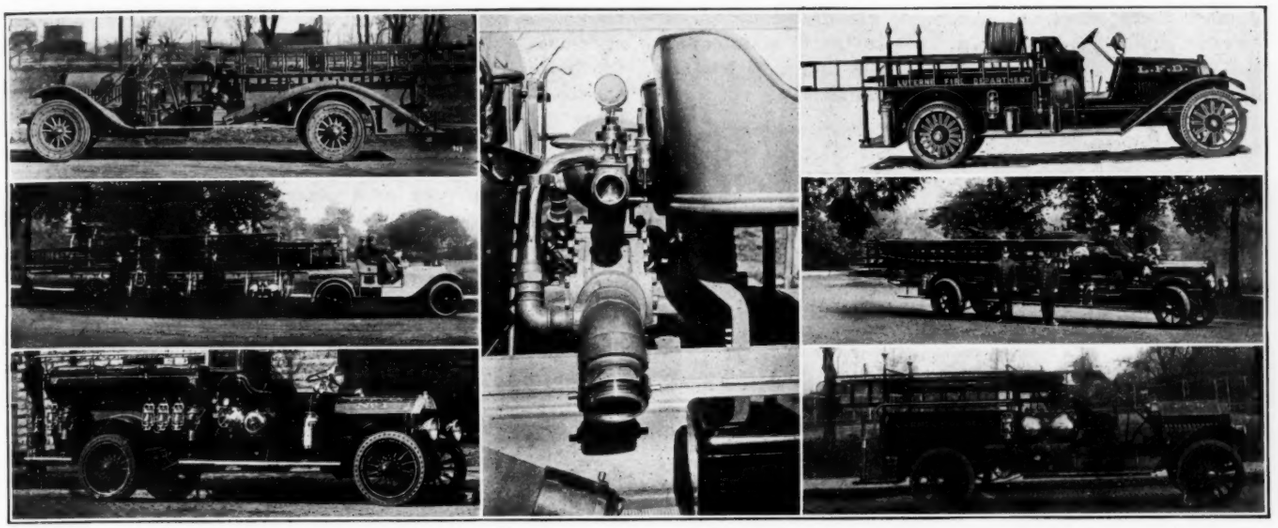
Cost of Seven Years' Maintenance.

"This engine has seen service in three different fire stations, and for your information, the following statement will give you an idea of the cost of maintenance, as compared with horse-drawn apparatus, covering a period of seven years, three months and twelve days to date, March 28, 1916:

"The total cost of maintenance for this period was $1,444.08. This was for gasoline, oil, spark plugs, minor repairs, repairs for two accidents (totaling $269.77), pneumatic tires (since equipped with Sewell cushion wheels) and solid tires, at a cost of $472.30. Every item of expense, including new equipment, we charged to the pumper and I assure you that every cent that was expended on this machine is included in the $1,444.08.



WEBB PUMPER, LANSING, MICH., SAID TO BE FIRST MOTOR PUMPER BUILT TO ORDER IN THE UNITED STATES.



NEW DEVELOPMENTS IN MOTOR FIRE APPARATUS.

WHITE PUMPER COMBINATION, CITY OF NEW BEDFORD, MASS.

WHITE TRACTOR, CITY OF ORANGE, N. J.

INDIANA CONST., HOSE WAGON, CITY OF OTTAWA, ILL.

PUMP OF WHITE, NEW BEDFORD, MASS., COMBINATION. DELIVERED 800 GALLONS PER MINUTE FROM 11-FOOT LIFT IN DRAFTING SALT WATER. PINION GEAR CONNECTION BETWEEN ENGINE AND PUMP.

LUVERNE COMBINATION, CITY OF LUVERNE, MINN.

WHITE LADDER TRUCK, CITY OF ORANGE, N. J.

HOWE COMBINATION, CITY OF CARMEL, N. Y.

"Four horses would be required to do the same work—two on the engine and two on an accompanying hose wagon. Figuring the upkeep at $18 a month per horse or $864 a year for the four horses, brings the total, in seven years, three months and twelve days, to $6,292.80. At least two of these horses would have outlived their usefulness in the service, in this length of time, which would add $400 more. This you will find a fair comparison for I am charging new equipment to the auto engine. Add $50 a year more to the steam engine and hose wagon for fuel, oil, repairs, etc. This would give you a grand total of $7,056.86, less auto engine expense, $1,444.08, leaving a balance in favor of the auto engine of $5,612.78. You will find these figures absolutely correct and all auto apparatus in our department will average about the same in comparison.

"Since the buying of this small auto engine (capacity 550 gallons), we have purchased one other Webb auto pumping engine (capacity 700 gallons), also one Robinson Jumbo pumping engine (capacity 900 gallons). We have also added one straight double tank chemical engine and two combination hose and chemical cars. The chief's car was purchased in 1908, from the Olds Motor Works. This car has also been in service ever since. Detroit bought her chief the first chief's car in Michigan and soon thereafter Lansing purchased one. These two cars, as near as I can ascertain, were the fourth and fifth chief's cars in the country."

Standardizing Fire Equipment.

By motorizing the fire department and standardizing the equipment, the city of Orange, N. J., has reduced fire losses until it ranks first among the cities with the lowest per capita fire loss for the past year. The city has officially recorded its appreciation of the services of Fire Chief William H. Mathews, who has been unsparing in his efforts to bring about this efficiency.

It is believed by those who planned a model fire department for Orange that standardization of apparatus was essential. Just motorization would not guarantee everything in the way of improvements sought for.

"Quick response to all alarms by all the fire-fighting force—that is what we need to save property and lives. If one piece of apparatus arrives promptly, a second piece ten minutes later and a third a few minutes later, there is more or less confusion and valuable time is lost. But with all apparatus standardized, all arrives simultaneously and we go after the flames as one complete fire-fighting unit. Standardization is as important as motorization. We get to the fire quickly, we get there together and we get back quickly," says Chief Mathews.

The city of Orange, N. J., now owns one White 6-cylinder 60-h.p. truck, used as a tractor to motorize a horse-drawn hook and ladder; three White 4-cylinder combination chemical and hose trucks and one 4-cylinder 30-h.p. chief's roadster.

But Four Minutes Away.

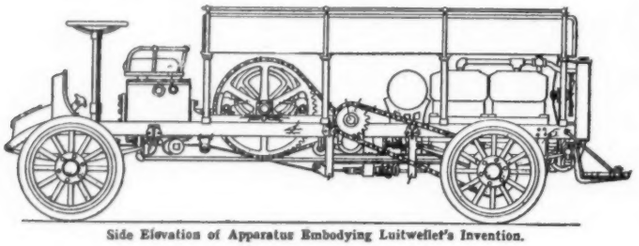
This equipment has brought the farthest alarm box within four minutes' run from the nearest fire station. The element of speed, always vital in a fire department, gave Orange concern when it began to consider motorization because of its hills. But the motor apparatus proved that the grades need not be considered when it demonstrated that hills, or no hills, the farthest fire box was but four minutes from the nearest fire station.

One of the possibilities of the new service was shown when Captain Thomas Hodgkinson took one of the combination trucks from headquarters to a fire 1½ miles distant in less than four minutes after the sounding of the alarm. In answering another alarm in the Orange Valley district, during a heavy snow storm, the truck averaged 18 miles an hour. This truck, in three years' service, never lost as much as a half minute, never failed to meet any emergency that confronted the fireman. All the equipment has passed the test of climbinb the roads up the Orange mountain.

Chief Mathews points out that the motors of the trucks are automatically started when an alarm is sounded. The self-starting switches are synchronized with the alarm system so that the engine starts when the gong rings. In winter all machines are equipped with warmers to keep heated the water in the radiators. This prevents delay due to chilled water and engine.

The first combination chemical and hose truck was installed November 4, 1912; answered 162 alarms the first year at an operating cost of $51.93, including tires. Compared with cost of horses, their feed, harness repairs, shoeing, veterinary bills

and other items when the equipment was drawn by horses, the motor equipment has shown a big saving in maintenance cost. Of course, in fire departments, this saving is but secondary to the great saving in property and lives.



Side Elevation of Apparatus Embodying Luitweiler's Invention.

Luitweiler Pumping Engine.

Letters patent have been issued to S. W. Luitweiler for an invention relating to that type of motor fire apparatus in which the motor is arranged to be used alternately for driving the vehicle and for driving a pump on the vehicle. The particular object of the invention is to construct and arrange the parts so as to secure great rigidity of the machine mechanism and to enable the parts to be assembled readily and securely; a further object of the invention consists in making provision for locking the clutch control between the engine and the pump when the latter is operating and to prevent the same being accidentally disconnected.

The inventor claims the following as new:

1. In a motor-propelled fire apparatus, the combination with an engine, of a drive shaft, a clutch for operatively connecting the engine and drive shaft, an operating member for the clutch, a lever, connections between the lever and the operating member, including an adjustable element which serves to connect and disconnect the lever with the operating member.

2. In a motor-propelled fire apparatus, the combination with an engine, of a drive shaft, a clutch for operatively connecting the engine and drive shaft, an operating member for the clutch, a lever controlling the operating member, and means movable with the lever and adapted to be moved independently of the lever for disconnecting it from the operating member.

New Type Combination Pumper.

The combining ladders, pump and hose in one piece of fire apparatus at New Bedford, Mass., is regarded as one of the most complete and efficient installations in the country. The ladders are one 35-foot extension, one 18-foot roof, one 12 and one 8-foot single ladder. The body carries 1,200 feet of fire hose. The pump is a rotary one with reducing plates for 800 gallons capacity. The fire-fighting equipment is mounted on a 6-cylinder, 60-h.p. White chassis.

No one is more enthusiastic over the success of this apparatus than New Bedford's chief engineer, C. F. Dahill. Mr. Dahill is regarded as an authority on fire extinguishing matters. He is the inventor of the Dahill rapid aerial hoist, the one-man simple hoist used generally thruout the country to raise the heavy fire ladders.

Asked about the combination apparatus, which is working under his direction, Chief Engineer Dahill said: "We like the machine very much. We have pumped over 800 gallons per minute from a plug and 727 gallons per minute drafting water from an 11-foot lift, salt water, using three lines siamesed into an Eastman deluge set. The connection between the engine and pump is by pinion gears, a three to one reduction, as the pump speed at capacity is 500 revolutions and the engine is 1,500. The engine is all that could be desired."

Tacoma, Wash., Cost Data.

The following comparative cost records are submitted by Mr. Geo. McAlevy, fire chief, Tacoma, Wash.:

AERIAL TRUCK, TRACTOR DRAWN.

(Cost for Twelve Months.)

Cost of repairs, including labor and material	$365.21
Lubricating oil	28.84
Gasoline	82.20
Total cost for twelve months	$476.25
Number of miles traveled	328
Cost per mile	$ 1.45

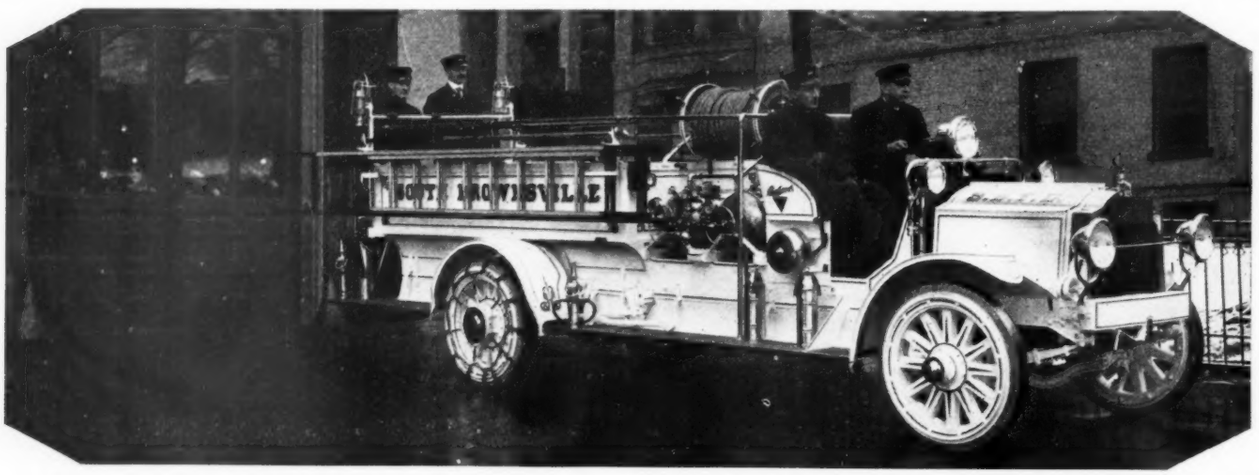
AERIAL TRUCK, THREE-HORSE DRAWN.

(Cost for Twelve Months.)

Cost of maintenance with same equipment	$924.13
Number of miles traveled	290
Cost per mile	$ 3.18
Cost of repairs, including labor and material	$ 91.86
Lubricating oil	27.79
Gasoline	70.00
Total cost for twelve months	$189.65
Miles traveled	215
Cost per mile	$ .88

HORSE-DRAWN COMBINATION HOSE AND CHEMICAL.

Cost of 3-horse combination, twelve months	$708.58
Number of miles traveled	298
Cost per mile	$ 2.38



PACKARD 3-TON COMBINATION, BORO OF BROWNSVILLE, PA. NINE-TENTHS OF THE LOAD IS CARRIED ON THE REAR WHEELS, GIVING THE MAXIMUM OF TRACTIVE EFFORT FOR SLIPPERY STREETS OR STEEP HILLS. THE POSITIVE BRAKES, CAPABLE OF LOCKING THE REAR WHEELS UNDER FULL LOAD, ARE AN IMPORTANT SAFEGUARD.

PLAIN CHEMICAL.

Repairs, including labor and material	$196.27
Lubricating oil	5.53
Gasoline	38.81
Total expense for twelve months	$240.61
Number of miles traveled	147
Cost per mile	$ 1.63

PLAIN HORSE-DRAWN CHEMICAL.

Cost of 2-horse chemical, twelve months	$465.00
Number of miles traveled	100
Cost per mile	$ 4.65

FIRST SIZE THREE-HORSE-DRAWN STEAMER.

Maintenance 3 horses, seven months	$441.81
Lubricating oil	24.50
Coke and coal	156.24
Repairs	32.70
Total cost for seven months	$655.25
Miles traveled	109
Cost per mile	$ 6.01

EXTRA FIRST SIZE MOTOR AND PUMPING ENGINE.

Repairs, including labor and material for seven months	$176.43
Lubricating oil	19.90
Gasoline	53.00
Total cost for seven months	$249.33
Number of miles traveled	117
Cost per mile	$ 2.13

Blasting Frozen Ground for Sewer Trench

S. R. Bowen, contracting engineer at Mason City, Iowa, in his circular letter No. 30, to the foremen on his work, gave the following description of the methods and results of blasting the frozen soil in starting a sewer trench:

They broke 50 feet of frost on the North Main street sewer this morning in 2½ hours. This material did not fly to speak of, and had a light covering of boiler iron. Two men with a point 3 feet long and a little larger round at the top than the bottom put down the holes in a short time. When the weather was cold they heated the bar. These holes were 18 inches deep and the frost is 2 to 2½ feet deep. After driving the point in they turned it and pulled it out with a 16-inch Stilson wrench.

These holes were placed zigzag in two lines about 18 inches apart. This opened a ditch 3 feet wide, and was taken out by two men.

These holes were loaded with half a stick of 40 per cent. dynamite and exploded with a No. 6 Du Pont electric fuse. The dynamite was Red Cross Extra. Four holes were shot at a time because a plate glass window was within 30 feet of the shots. They have been doing this for several days, and have been able to get in 40 feet of pipe each day with a crew of twenty men. The trench is 15 feet deep in sand and water and has to be sheeted all of the way, and they keep the backfill up to the end of the pipe every day, so it does not have over 24 hours to freeze at the longest. I think that you will be able to make equal or better progress, governed by the class of work you are encountering, and hope to note some improvements on the plan outlined.

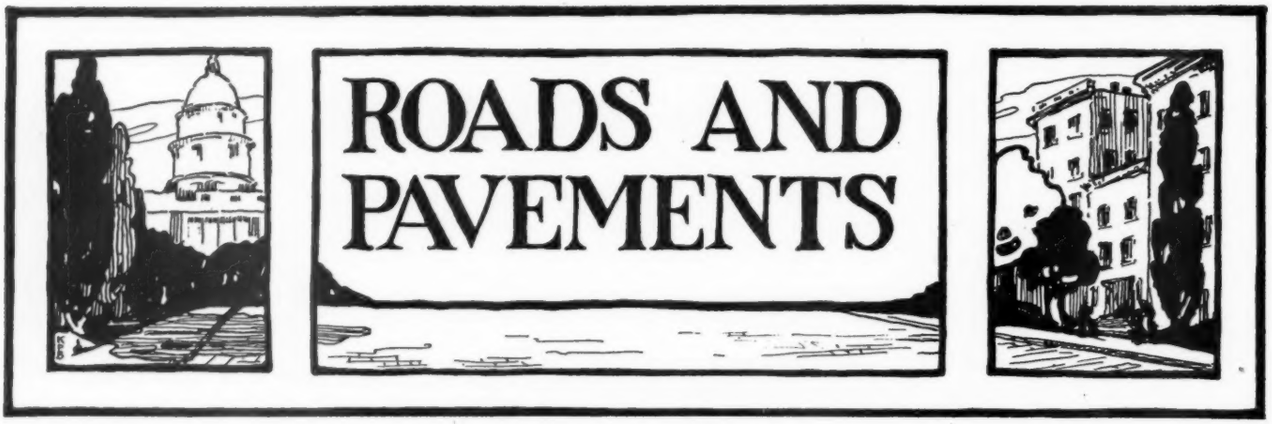
Motor Equipment of Fire and Police Departments

(Continued from page 45 of the "Motor Trucks in Public Service" insert in the April number.)

City or Town—State	Name of Make	Model	Capacity	Cyl.	H. P.	Description	Dept.	No. of Pieces	Years Service	Price of Each	Speed Mi. per Hour	Chassis Weight	Special Features
Niles, Mich.	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	....	.....	...	.....	
Nashville, Tenn.	The White Co.	....	¾ ton	..	30	Patrol	Police	2	....	.....	...	.....	
Newark, N. J.	The White Co.	....	¾ ton	..	30	Patrol	Police	2	....	.....	...	.....	
New Britain, Conn.	The White Co.	....	¾ ton	..	30	Patrol	Police	1	....	.....	...	.....	
New Castle, Pa.	The White Co.	....	¾ ton	..	30	Patrol	Police	1	....	.....	...	.....	
New Haven, Conn.	The White Co.	....	¾ ton	..	30	Patrol	Police	2	....	.....	...	.....	
Newport, R. I.	The White Co.	....	¾ ton	..	30	Patrol	Police	1	....	.....	...	.....	
Norwood, O.	The White Co.	....	¾ ton	..	60	Patrol	Police	1	....	.....	...	.....	
New York City, N. Y.	Garford	65A	.....	4	30	Patrol wagon	Police	10	2	.....	25	.....	Regulation patrol type
New York City, N. Y.	Garford	H	.....	4	40	Patrol wagon	Police	3	4	.....	25	.....	Regulation patrol type
North Yakima, Wash.	Couple Gear	....	4 ton	4	60	Aerial ladder	Fire fighting	1	4	10,500	25	10,000	4 wheel self-contained aerial
New York City, N. Y.	Couple Gear	A	5 ton	Batt.		Steamer tractor	Fire fighting	1	4	4,000	17	8,000	2 wheel steamer
New York City, N. Y.	Couple Gear	H	4 ton	4	60	Aerial ladder	Fire fighting	4	3	10,500	20	10,000	4 wheel self-contained aerials
New York City, N. Y.	Couple Gear	H	6 ton	4	60	Water tower tractir	Fire fighting	3	4	5,400	20	10,000	4 wheel drive & steamer tractor
New York City, N. Y.	Gen. Motors	15	¾ ton	4	28	Ambulance	Police ambulance	2	1	1,900	20	2,510	Ambulance
New York City, N. Y.	Gen. Motors	1F	½ ton	Elec.		Ambulance	Police ambulance	2	2	3,000	12	2,500	Ambulance
New York City, N. Y.	The White Co.	....	5 ton	..	40	Supply trucks	Fire	15	....	.....	...	.....	
New York, N. Y.	Mack	....	3 ton	4	48	High pressure hose	Fire fighting	24	1915	4,160	25	8,000	
New York, N. Y.	Mack	....	3 ton	4	48	High pressure hose	Fire fighting	3	3	4,625	25	8,500	
New York, N. Y.	Couple Gear	....	5 ton	Batt.		Tractor	Fire fighting	1	4	4,000	17	7,000	
New York, N. Y.	Trumbull	....	A ¾ ton	4	18		Police	3	1	395	50	800	
New York, N. Y.	Mack	....	B 1½ ton	4	32		Fire fighting	2	4	3,000	18	4,700	
New York, N. Y.	Mack	....	3 ton	4	48	H. P. hose	Fire fighting	2	3½	4,500	25	8,000	
New York, N. Y.	Mack	....	2 ton	4	32	Comb. chemical	Fire fighting	5	3	4,045	35	4,000	
New York, N. Y.	Mack	....	2 ton	4	32	Comb. chemical	Fire fighting	20	3	4,045	35	4,000	
New York, N. Y.	Mack	....	2 ton	4	32	Supply	Fire fighting	2	2½	3,300	18	4,900	
New York, N. Y.	Mack	....	2 ton	4	32	Comb. chemical	Fire fighting	4	1½	4,045	35	4,900	
New York, N. Y.	Mack	....	2 ton	4	32	Instruction truck	Fire fighting	1	2	3,135	35	4,900	

City or Town—State	Name of Make	Model	Capacity	Cyl.	H. P.	Description	Dept.	No. of Pieces	Years Service	Price of Each	Speed Mi. per Hour	Chassis Weight	Special Features
New York, N. Y.	Mack	....	2 ton	4	32	Comb. chemical	Fire fightnig	3	1	3,250	35	4,900	
New York, N. Y.	Mack	....	3 ton	4	48	H. P. hose	Fire fighting	10	2½	4,160	25	8,000	
New York, N. Y.	Mack	....	3 ton	4	48	H. P. hose	Fire fighting	20	1	4,160	25	8,000	
New York, N. Y.	Mack	....	3 ton	4	48	City service trucks	Fire fighting	10	1/3	5,625	10	7,600	
New Haven, Conn.	Couple Gear	HT	3½ ton		Batt.	Tractor	Fire fighting	1	2	5,000	20	9,000	
New Haven, Conn.	Couple Gear	HT	3½ ton		Batt.	Tractor	Fire fighting	3	2	3,750	20	6,000	
New Haven, Conn.	Couple Gear	HT	3½ ton		Batt.	Tractor	Fire fighting	1	3	5,400	20	10,000	
New Haven, Conn.	Couple Gear	AF	5 ton		Batt.	Tractor	Fire fighting	1	2	4,000	17	8,000	
Newark, N. J.	Mack	....	3 ton	4	48	Hook & ladder	Fire fighting	1	2	11,000	25	10,000	
North Yakima, Wash.	Couple Gear	A	5 ton	4	65	Aerial ladder	Fire fighting	1	4	11,000	20	10,000	
Oelwein, Iowa	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Ocean City, N. J.	The White Co.	....	1½ ton	..	30	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Omaha, Neb.	Gen. Motors	15	¾ ton	4	28	Police patrol	Police patrol	1	¾	1,975	25	2,510	Comb. patrol and ambulance
Ocean City, N. J.	The White Co.	....	¾ ton	..	30	Tractors	Fire fighting	2	...	.....	..	.....	
Ocean City, N. J.	The White Co.	....	.....	..	30		Chief's car	1	...	.....	..	.....	
Oshkosh, Wis.	The White Co.	....	3 ton	..	60	Service ladder	Fire fighting	1	...	.....	..	.....	
Ottumwa, Iowa	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	2	...	.....	..	.....	
Oak Park, Ill.	The White Co.	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Omaha, Neb.	The White Co.	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Oshkosh, Wis.	The White Co.	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Oyster Bay, N. Y.	Garford	66	.....	4	23	Hose & chemical	Fire fighting	1	...	.....	25	.....	Reg. Comb. job
Parnassur, Pa.	Packard	D	3 ton	4	32	Hose & chemical	Fire fighting	1	1-3	4,175	30	6,900	Two 40-gal. Chem. tanks, 3 ladders, 800 [ft. of hose
Pawtucket, Conn.	The White Co.	....	1½ ton	..	45	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Petaluma, Cal.	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Philadelphia, Pa.	The White Co.	....	¾ ton	..	30	Supply trucks	Fire fighting	2	...	.....	..	.....	
Philadelphia, Pa.	The White Co.	....	.....	..	60		Chief's car	1	...	.....	..	.....	
Pittsburg, Kans.	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Pittsburg, Kans.	The White Co.	....	.....	..	30		Chief's car	1	...	.....	..	.....	
Portland, Ore.	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Portland, Ore.	The White Co.	....	¾ ton	..	60	Chemical truck	Fire fighting	1	...	.....	..	.....	
Portland, Ore.	The White Co.	....	3 ton	..	30	Supply truck	Fire fighting	1	...	.....	..	.....	
Pottsville, Pa.	The White Co.	....	1½ ton	..	40	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Poughkeepsie, N. Y.	The White Co.	.....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Puvalley, Wash.	The White Co.	....	1½ ton	..	30	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Passaic, N. J.	The White Co.	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Philadelphia, Pa.	The White Co.	....	¾ ton	..	30	Patrol	Police	2	...	.....	..	.....	
Pittsburgh, Pa.	The White Co.	....	¾ ton	..	40	Patrol	Police	11	...	.....	..	.....	
Poughkeepsie, N. Y.	The White Co.	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Providence, R. I.	The White Co.	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Pt. Washington, N. Y.	Garford	66	.....	4	23	Hose & chemical	Fire fighting	1	1	.....	25	.....	Reg. combination job
Pueblo, Colo.	Garford	65A	.....	4	30	Hose & chemical	Fire fighting	3	3	.....	25	.....	Reg. combination job
Philadelphia, Pa.	Couple Gear	H	4 ton	4	60	Aerial ladder	Fire fighting	1	3	10,500	20	10,000	Self-contained aerial
Philadelphia, Pa.	Couple Gear	H	4 ton	4	60	Tractor for water tower	Fire fighting	1	3	5,000	20	9,000	4 wheel drive tractor
Philadelphia, Pa.	Couple Gear	A	5 ton		Batt.	Tractor for steamer	Fire fighting	1	3	4,000	20	7,000	2 wheel drive tractor
Piermont, N. Y.	Mack	....	1½ ton	4	32	Hose truck	Fire fighting	1	1	3,035	35	4,800	
Phoenix, Ariz.	Mack	....	2 ton	4	32	Express	Fire fighting	1	2	3,215	18	4,900	
Providence, R. I.	Auto Car	....	.....	..	..	Hose & chemical	Fire fighting	1	1	2,900	..	.....	
Paterson, N. J.	Mack	....	3 ton	4	48	Comb. chemical	Fire fighting	2	½	5,000	25	7,600	
Philadelphia, Pa.	Mack	....	3 ton	4	48	Comb. chemical	Fire fighting	1	3½	4,950	25	7,600	
Philadelphia, Pa.	Mack	....	3 ton	4	48	Comb. chemical	Fire fighting	7	1½	5,120	25	7,600	
Philadelphia, Pa.	Mack	....	3 ton	4	48	Comb. chemical	Fire fighting	4	¼	5,120	25	7,600	
Philadelphia, Pa.	Mack	....	2 ton	4	32	High pressure hose	Fire fighting	1	3½	3,252	35	4,900	
Philadelphia, Pa.	Mack	....	2 ton	4	32	Hose wagon	Fire fighting	1	3	3,600	35	4,900	
Philadelphia, Pa.	Mack	....	3 ton	4	48	Fire	Police	5	3	2,800	20	3,900	
Philadelphia, Pa.	G. M. C.	V	2¼ ton	4	25	Patrol	Fire fighting	1	2	4,000	17	7,000	
Philadelphia, Pa.	Couple Gear	A	5 ton		Batt.	Steamer tractor	Fire fighting	4	4	11,000	20	10,000	
Philadelphia, Pa.	Couple Gear	H	3½ ton	4	60	Aerial	Fire fighting	3	4	5,000	25	9,000	
Portland, Ore.	Couple Gear	H2	3½ ton	4	60	Water tower tractor	Police	1	1	2,500	30	4,000	
Plainfield, N. J.	Federal	H	1½ ton	4	30	Police patrol & ambulance	Fire fighting	1	3	3,750	35	4,900	
Quincy, Mass.	The White Co.	....	1½ ton	..	60	Squad trucks	Fire fighting	2	...	.....	..	.....	
Quincy, Mass.	The White Co.	....	3 ton	..	60	Service ladders	Fire fighting	2	...	.....	..	.....	
River Forest, Ill.	Packard	D	2 ton	4	25	Hose & chemical	Fire fighting	1	1-12	4,550	30	5,133	Hose, Chem. ladders, etc., in usual Comb.
Rock Island, Ill.	Gen. Motors	15	¾ ton	4	28	Police patrol	Patrol	1	¾	1,975	25	2,510	Com. patrol & ambulance
Reading, Pa.	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Roland Park, Md.	The White Co.	....	¾ ton	..	30	Ladder truck	Fire fighting	1	...	.....	..	.....	
Roland Park, Md.	The White Co.	....	.....	..	30		Chief's car	1	...	.....	..	.....	
Republic of Panama	The White Co.	....	1½ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Roselle Park, N. J.	Mack	....	2¾ ton	4	48	Comb. chemical	Fire fighting	1	1/6	4,000	35	6,000	
Richmond, Va.	Mack	....	2 ton	4	32	Comb. chemical	Fire fighting	4	½	2,350	30	4,800	
Roslyn, N. Y.	Mach	....	1½ ton	4	32	Chassis	Fire fighting	1	3	3,000	35	4,800	
Rochester, N. Y.	Mack	....	1½ ton	4	32	Hose truck	Fire fighting	1	2	2,700	35	4,900	
Rochester, N. Y.	Mack	....	2 ton	4	32	Chassis	Fire fighting	1	1	2,700	35	4,900	
Rochester, N. Y.	Mack	....	2 ton	4	32	Chassis	Fire fighting	2	1	2,700	35	4,900	
Rye, N. Y.	Mack	....	2 ton	4	32	Chassis	Fire fighting	1	2	5,042	35	4,900	

Springfield, Ohio	Kelly-Springfield	K31	1½ ton	4	30	Comb. Hose & chemical	Fire fighting	2	3	4,250	35	4,000	Peter Pirsh & Son, hose & Chem. equipm't
Springfield, Ohio	Kelly-Springfield	D30	1 ton	4	30	Comb. Hose & chemical	Fire fighting	1	5	5,250	35	4,000	Pefer Pirsh & Son, hose & Chem. equipm't
Springfield, Ohio	Kelly-Springfield	K31	1½ ton	4	30	Comb. Hose & chemical	Fire fighting	1	1-12	4,250	35	4,000	Amer.-La France hose & Chem. equipm't
Springfield, Ohio	Kelly-Springfield	K31	1½ ton	4	30	Police patrol	Police	1	3	4,250	25	4,000	Studebaker police patrol body
San Anselmo, Cal	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
San Francisco, Cal	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	2	...	.....	..	.....	
San Francisco, Cal	The White Co.	....	1½ ton	..	30	Supply truck	Fire fighting	1	...	.....	..	.....	
Santa Anna, Cal	The White Co.	....	1½ ton	..	45	Hose & chemical	Fire fighting	2	...	.....	..	.....	
Sioux City, Iowa	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	3	...	.....	..	.....	
Sioux City, Iowa	The White Co.	....	3 ton	..	60	Service ladder	Fire fighting	1	...	.....	..	.....	
Southbridge, Mass	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
So. Manchester, Conn	The White Co.	....	¾ ton	..	30	Hose truck	Fire fighting	1	...	.....	..	.....	
Statesville, N. C	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Stockton, Cal	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
St. Louis, Mo	The White Co.	....	¾ ton	..	30	Patrol	Police	4	...	.....	..	.....	
St. Paul, Minn	The White Co.	....	¾ ton	..	30	Patrol	Police	2	...	.....	..	.....	
St. Paul, Minn	The White Co.	....	1½ ton	..	60	Patrol	Police	1	...	.....	..	.....	
San Antonio, Tex	The White Co.	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Sandusky, Ohio	The White Co.	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Saskatoon, Sask	The White Co.	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Savannah, Ga	The White Co.	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Somerville, Mass	The White Co.	....	¾ ton	..	40	Patrol	Police	1	...	.....	..	.....	
Springfield, Mass	The White Co.	....	¾ ton	..	40	Patrol	Police	1	...	.....	..	.....	
Syracuse, N. Y	The White Co.	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Shreveport, La	Garford	65	.....	4	30	Hose & chemical	Fire fighting	1	3	.....	25	.....	Reg. Comb. job
South Bend, Ind	South Bend	C80	.....	4	80	Chemical engine	Fire fighting	1	2	5,000	50	5,950	Two 75-gal. tanks
South Bend, Ind	South Bend	H80	.....	4	80	Hose wagon	Fire fighting	2	2	3,500	50	5,950	1,500 ft. 2½-in. hose, 2 ladders, etc
South Bend, Ind	South Bend	H60	.....	4	60	Hose wagon	Fire fighting	1	3	3,000	45	5,700	1,200 ft. hose, 2 ladders, etc.
South Bend, Ind	South Bend	H80	.....	4	80	Ambulance	Fire fighting	1	1½	5,000	50	5,950	Two cots, electric fan, etc.
Springfield, Mass	Couple Gear	H	3 ton	..	..	Hose & chemical	Fire fighting	2	5	5,900	30	6,000	
Springfield, Mass	Couple Gear	HT	6 ton	..	..	Ladder tractor	Fire fighting	1	4	5,200	25	9,000	
Springfield, Mass	Couple Gear	A	5 ton	..	..	Aerial ladder	Fire fighting	3	4	11,000	25	11,000	4 wheel self-contained aerial
San Francisco, Cal	Mack	....	2 ton	4	32	Comb. chemical	Police	2	1	2,500	30	4,000	
St. Louis, Mo	Federal	H	1½ ton	4	30	Police patrol & ambulance	Fire fighting	1	3	2,000	15	4,000	
San Jose, Cal	Federal	H	1½ ton	4	30	Sercise car	Police	1	2	2,500	30	4,000	
Sharon Hill, Pa	Sederal M. & T. Co	H	1½ ton	4	30	Police patrol & ambulance	Fire fighting	..	2½	.....	15	.....	
Springfield, Mass	International	M	½ ton	2	20	Fire truck	Fire fighting	6	5	11,000	20	10,000	
Tacoma, Wash	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Terre Haute, Ind	The White Co.	....	1½ ton	..	45	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Texarkana, Tex	The White Co.	....	1½ ton	..	30	Hose & chemical	Fire fighting	2	...	.....	..	.....	
Topeka, Kans	The White Co.	....	.....	..	30		Chief's car	1	...	.....	..	.....	
Toronto, Ont	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	2	...	.....	..	.....	
Toronto, Ont	The White Co.	....	¾ ton	..	40	Patrol	Police	1	...	.....	..	.....	
Trenton, N. J	Couple Gear	A	5 ton	4	60	Aerial ladder	Fire fighting	1	3	11,000	25	11,000	4 wheel drive self-contained
Trenton, N. J	Couple Gear	A	5 ton	4	60	Steamer tractor	Fire fighting	2	2	4,500	20	8,000	Front drive steamer tractor
Taunton, Miss	Couple Gear	H	3½ ton	4	60	Hose, chem. & aerial ladder	Fire fighting	1	2½	2,600	35	4,000	
Taunton, Miss	Mack	....	1 ton	4	32	Chassis	Fire fighting	1	1½	2,100	35	4,500	
Trenton, N. J	Mack	....	1 ton	4	32	Chassis	Fire fighting	2	2	4,500	17	8,000	
Visalia, Cal	The White Co.	....	1½ ton	..	60	Chemical trucks	Fire fighting	2	...	.....	..	.....	
Visalia, Cal	The White Co.	....	1½ ton	..	60	Hose truck	Fire fighting	1	...	.....	..	.....	
Vancouver, Wash	Couple Gear	H	4 ton	4	60	Aerial ladder	Fire fighting	1	4	10,500	25	10,000	4 wheel self-contained aerial
Vancouver, B. C	Couple Gear	A	5 ton	4	65	Tractor	Fire fighting	1	4½	11,000	20	10,000	
Wilmington, Del	Mack	....	2 ton	4	32	Chassis	Fire fighting	1	2	2,800	35	4,900	
Wilkes Barre, Pa	Mack	....	3 ton	4	48	Comb. chemical	Fire fighting	1	1/3	4,750	25	7,600	
Washington, D. C	Couple Gear	H	3½ ton	4	60	Aerial	Fire fighting	1	3	11,000	20	10,000	
Wilmington, Del	Couple Gear	H	3½ ton	4	60	Aerial ladder	Fire fighting	1	1	11,000	25	11,000	
Wilmington, Del	Couple Gear	A	5 ton	4	80	Aerial ladder	Fire fighting	1	1	3,100	35	4,800	
Wilkes Barre, Pa	Mack	....	1½ ton	4	32	Hose body	Fire fighting	6	¼	5,000	25	7,600	
Winnetka, Ill	Packard	B	2 ton	4	26	Hose & chemical	Fire fighting	1	1	4,300	30	5,220	Hose, Chem., ladder, etc., in usual Comb.
West Point, Va	Kelly-Springfield	K31	1½ ton	4	30	Hose & chemical	Fire fighting	1	1½	4,250	35	4,000	Peter Prisch & Son, hose & chemical.
Washington, D. C	The White Co.	....	1½ ton	..	40	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Waterville, Me	The White Co.	....	1½ ton	..	60	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Waterville, Me	The White Co.	....	1½ ton	..	30	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Weston, Mass	The White Co.	....	1½ ton	..	45	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Whitehall, Pa	The White Co.	....	¾ ton	..	30	Hose & chemical	Fire fighting	1	...	.....	..	.....	
Wilkes-Barre, Pa	The White Co.	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Wilmington, N. C	The White Co.	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	
Woonsocket, R. I	The White Co.	....	¾ ton	..	40	Patrol	Police	1	...	.....	..	.....	
Worcester, Mass	The White Co.	....	¾ ton	..	40	Patrol	Police	1	...	.....	..	.....	
Wellsville, Ohio	Garford	65A	.....	4	30	Hose & chemical	Fire fighting	1	2	.....	25	.....	Reg. combination job
Woodbridge, N. Y	Garford	65	.....	4	30	Hose & chemical	Fire fighting	1	2	.....	25	.....	Reg. combination job
Wharton, Texas	Garford	65	.....	4	30	Hose & chemical	Fire fighting	1	2	.....	25	.....	Reg. combination job
Washington, D. C	Couple Gear	H	4 ton	4	60	Aerial ladder	Fire fighting	1	3	10,500	25	10,000	4 wheel self-contained aerial
Wilmington, Del	Couple Gear	A	5 ton	5	90	Aerial ladder	Fire fighting	1	2	11,500	20	11,000	4 wheel self-contained aerial
Yonkers, N. Y	The White Co.	....	.....	..	30		Chief's car	1	...	.....	..	.....	
Yonkers, N. Y	The White Co.	....	¾ ton	..	30	Patrol	Police	1	...	.....	..	.....	



Prizes for Road Photographs

The National Highways Association offers cash prizes for photographs of roads as follows:

The most striking good or bad road photograph, $500; five second prizes of $100 each; twenty third prizes of $25 each; forty fourth prizes of $15 each; one hundred fifth prizes of $5 each, or 166 prizes in all, amounting to $2,600. The photographs will be used in an exhibit at Washington intended to show the value of good roads. The contest will close November 7 at noon. All photographs should be addressed to Good Roads Everywhere Photograph Contest, National Highways Association, Washington, D. C. Charles Henry Davis, C. E., Cambridge, Mass., is president of the association.

Awards Under Vermillion County, Illinois, Bond Issue

Division No. 1: Awarded to Harding and Slattery, of Crawfordsville, Ind., for concrete, at their gross bid of $116,444; unit price per square yard of pavement, 70 cents.

Division No. 2: Awarded to Granite City Lime and Cement Co., of Granite City, Ill., for brick with 4 to 5-inch concrete base, and concrete, at their gross bid of $234,800 and $128,800; unit price per square yard of pavement, $1.51 and 69.5 cents, respectively; brick to be laid on Dixie Highway.

Division No. 3: Awarded to A. D. Thompson, of Peoria, Ill., for concrete, at their gross bid of $113,053; unit price per square yard of pavement, 70 cents.

Division No. 4: Awarded to Eclipse Construction Co., of Winnetka, Ill., for brick with 4 to 5-inch concrete base, and concrete, at their gross bid of $196,093.82 and $104,784.84; unit price per square yard of pavement, $1.58 and 60 cents, respectively; brick to be laid on Dixie Highway.

Division No. 5: Awarded to Prendergast-Clark Construction Co., St. Louis, Mo., for concrete, at their gross bid of $124,800; unit price per square yard of pavement, 70 cents.

Division No. 6: Awarded to M. J. Herrick, of St. Louis, Mo., for brick with 4 to 5-inch concrete base, and concrete, at their gross bid of $220,528 and $99,897; unit price per square yard of pavement, $1.81 and 61 cents, respectively; brick to be laid east of Oakwood.

Division No. 7: Awarded to Granite City Lime and Cement Co., of Granite City, Ill., for brick with 4 to 5-inch concrete base, and concrete, at their gross bid of $202,000 and $119,000; unit price per square yard of pavement, $1.49 and 69 cents, respectively; brick to be laid east of Catlin.

Division No. 8: Awarded to P. M. Johnson & Co., of St. Elmo, Ill., for concrete, at their gross bid of $113,200; unit price per square yard of pavement, 61 cents.

Division No. 9: Awarded to Ewing, Shields & Co., of Greencastle, Ind., for brick with 4 to 5-inch concrete base, and concrete, at their gross bid of $257,000 and $145,980; unit price per square yard of pavement, $1.70 and 72 cents respectively; brick to be laid north of Georgetown. Division No. 9 afterwards awarded to Eclipse Construction Co., who sublet to McCalman Construction Co., of Decatur, Ill.

The contractors, material men and equipment salesmen are outspoken in their praise of the courtesy shown, the facilities and accommodations for work given by the road commissioners and Chief Engineer P. C. McArdle.

There was no question as to detail of construction, choice of material, description of material, grade; in fact, any engineering information at all, that was not furnished at once and fully by the superintending engineer's office. Plans, profiles, cross-sections, quantities of work, every item that could possibly come up for investigation, had been thoroly investigated and the results tabulated and made available for instant use, and the most trivial things were given the same careful attention as the most important.

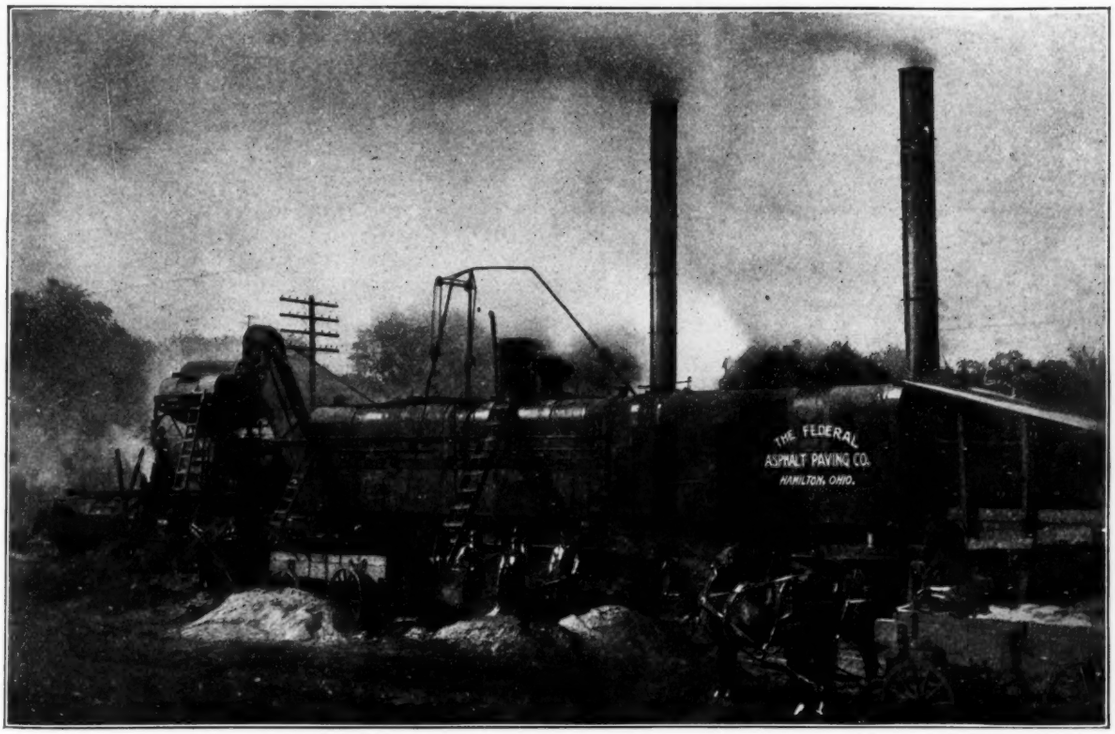
Methods of Prominent Asphalt Contractor

The Federal Asphalt Paving Company, of Hamilton, O., organized during the latter part of February, 1915, completed the work in connection with its contracts on November 26, after a very successful season's operations.

During the season this company laid a total of 122,097 square yards of pavements, all of same being either sheet asphalt or asphaltic concrete. It opened its season's operations in Charleston, W. Va., the third week in April, completing 37,928 square yards of asphaltic concrete pavement on June 30. The equipment was then moved to Marion, O., where 3,325 square yards of sheet asphalt pavement was completed by July 14. A contract at Sandusky, O., for the construction of 9,962 square yards of sheet asphalt was then opened and completed on August 12. From Sandusky, O., the equipment was shipped to Battle Creek, Mich., where the work in connection with the contract with that city was opened on August 18, and completed on September 11, during which time 36,867 square yards of asphaltic concrete wearing surface was laid. Work was then opened in the city of Wabash, Ind., and 16,545 square yards of sheet asphalt pavement completed by October 29, after which the equipment was shipped to Columbus, O., where the laying of 17,470 square yards of sheet asphalt wearing surface was completed on November 26.

ASPHALT PLANT IN OPERATION.

Trinidad Pitch Lake asphalt was used in the construction of all the pavements laid during the year, with the exception of the Charleston, W. Va., work, in which Mexican asphalt was used. The type of construction at Charleston, W. Va., was that known as asphaltic concrete with a 2-inch wearing surface and a 5-inch cement concrete base with a combination cement curb and gutter. At Marion, O., the work was con-



MERRIMAN ONE-CAR ASPHALT PLANT IN OPERATION.

structed under a sheet asphalt specification with a 1-inch binder and a 2-inch wearing surface on a 6-inch cement concrete base with a straight stone curb. Sheet asphalt with 1¼-inch binder and 1¾-inch wearing surface on a 6-inch cement concrete base, with cement combination curb and gutter, was the specification under which the Sandusky work was constructed. At Battle Creek, Mich., the specifications called for a 5-inch cement concrete base, with a 2-inch asphaltic concrete wearing surface. At Wabash, Ind., sheet asphalt, 1-inch binder, with 1½-inch wearing surface on 6-inch cement concrete base, with straight cement curb, was the specification under which the work was constructed. At Columbus, O., sheet asphalt, 1-inch close binder, with a 2-inch wearing surface laid on 6-inch cement concrete base, with straight Berea stone curb, was the specification.

The Merriman one car railroad portable asphalt plant was used for mixing and preparing the asphalt in connection with the above mentioned work. This type of asphalt plant heats the asphalt with steam, thereby preventing the overheating and burning of the asphalt cement during the course of preparation. It is provided with separate bins for heated stone or sand of various sizes, enabling the operator to get a perfect gradation of the materials for pavement mixtures.

MAKING A REPAIR.

In connection with the Charleston, W. Va., work, this plant mixed the material for an average of 2,209 square yards of pavement per 10-hour day, with 2,615 square yards as the largest output of any single day. At Battle Creek, Mich., this plant mixed the material necessary for an average of 2,348 square yards per 10-hour day, with 3,018 square yards as the largest output of any single day. An accompanying photograph shows the Merriman plant in operation during the construction of the Battle Creek pavement.

One of the accompanying cuts shows the operations necessary to making a repair in an asphalt pavement, produced from photographs taken at Wabash, Ind., where the street was being repaired after eighteen years of service with less than two cents per square yard maintenance during that period. These pictures show the ease with which an asphalt pavement can be repaired.

All of the work laid by The Federal Asphalt Paving Company during the year 1915, was constructed under the general supervision of the company's general manager, F. D. Sheley, who has had several years of experience in the construction of asphalt and other types of pavement. The setting of the asphalt mixtures is all under the supervision of the company's chemist, O. L. Butterbaugh, who not only graduated from the best school of asphalt chemistry in the United States, but has had years of experience in this line of work.

Aside from the asphalt plant proper, the company is equipped with concrete mixers, wagons, and all other machinery and tools necessary for the construction of the various types of street pavements, and has a complete organization of skilled foremen and workmen, and while it specializes in the laying of asphalt pavements, it does not expect to confine its operations to this alone if afforded an opportunity to construct other types of pavements where same are desired.

RECORD TIME ON FOUR CONTRACTS.

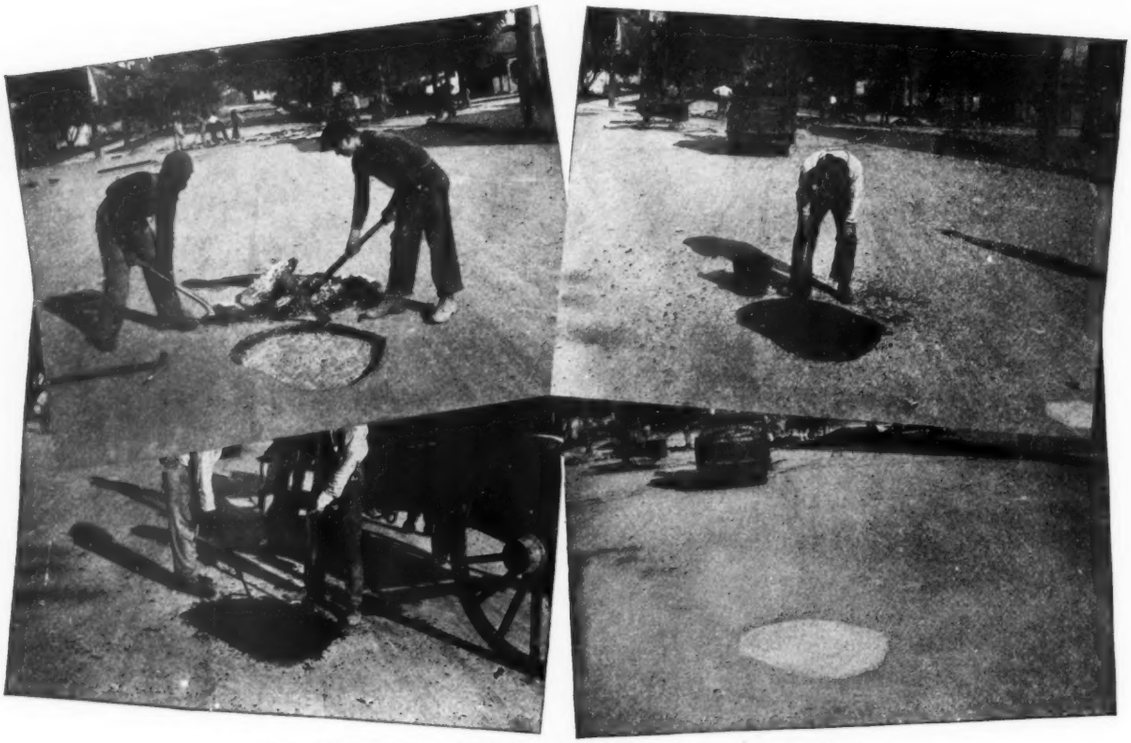
The following summary gives yardage laid and time consumed in actual work on four contracts from the above description:

Charleston, W. Va.—Laid 29, 386 square yards 2-inch asphaltic concrete in 133 hours, an average of 2,209 square yards per 10-hour day, with 2,615 square yards as the largest output of any single day.

Sandusky, O.—Laid 9,962 square yards of sheet asphalt with 1¼-inch binder and 1¾-inch top in 67 hours, an average of 1,486.8 square yards per 10-hour day.

Battle Creek, Mich.—Laid 36,865 square yards 2-inch asphaltic concrete in 157 hours, an average of 2,348 square yards per 10-hour day, with 3,018 square yards as the largest output of any single day.

Wabash, Ind.—Laid 10,968 square yards sheet asphalt pave-



THE OPERATIONS NECESSARY IN REPAIRING AN ASPHALT STREET.

CUTTING OUT THE DEFECTIVE SPOT.
TAMPING THE HOT ASPHALT MIXTURE IN PLACE.
PAINTING THE EDGES WITH ASPHALT CEMENT.
THE COMPLETE PATCH THOROLY ROLLED AND COMPACTED.

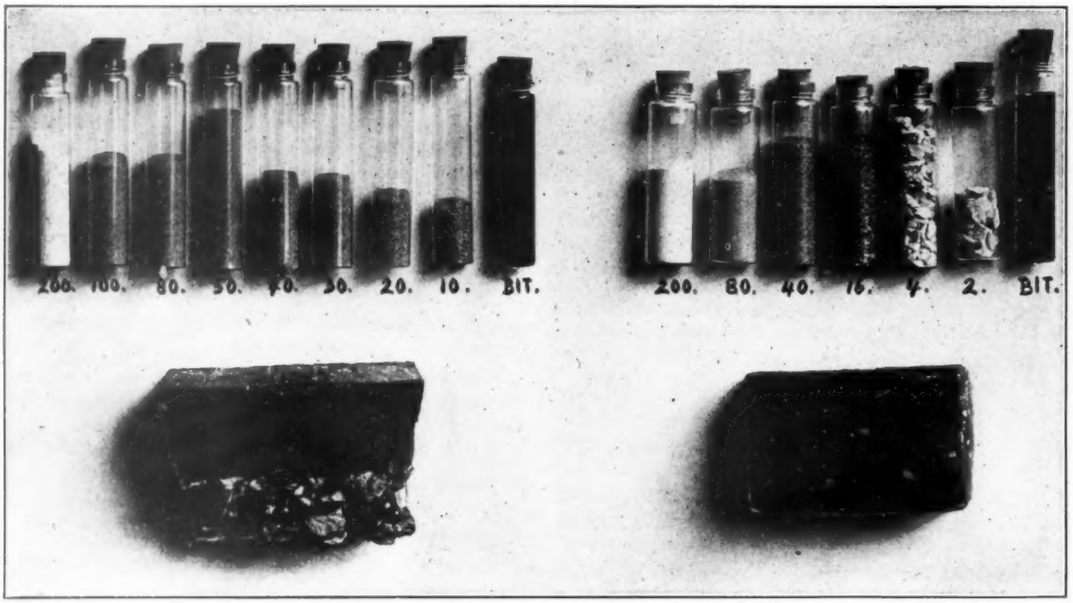
ment with 1-inch binder and 1½-inch top, an average of 1,482 square yards per 10-hour day.

EQUIPMENT USED.

Following is list of equipment used by The Federal Asphalt Paving Company on work herein described:

1 Merriman (large size) portable asphalt plant.
1 Ten-ton Kelly-Springfield asphalt roller.
1 Five-ton Kelly-Springfield asphalt roller.
1 Foote No. 6 "A" concrete mixer.
1 Car load Troy "Ajax" asphalt wagons.
1 Car load Moore grade dump wagons.
1 Chemist's asphalt laboratory outfit.
1 Ford roadster.

Plows, rooters, wheelbarrows, blacksmith tools, shovels, picks and six other small tools necessary.



SHEET ASPHALT 1½-INCH TOP TAKEN FROM MIAMI STREET, WABASH, IND., AFTER NINETEEN YEARS OF SERVICE.

ASPHALTIC CONCRETE 2 INCHES THICK, TAKEN FROM A STREET IN BATTLE CREEK, MICH., LAID BY THE FEDERAL ASPHALT PAVING COMPANY.

Strong Bond in Monolithic Pavement

The successful practical construction of monolithic brick pavements has opened a new field of theoretical engineering investigation. Whenever materials are combined to form an engineering structure, there enters the problem of economically distributing them in order that the structure as a whole may benefit most advantageously by the individual properties of the several elements. Thus in monolithic brick pavements the surface is composed of a material well adapted to resist attrition and compression, supported and held in place by a material well adapted for its purpose. Economic design then demands an equitable adjustment of these two elements in order that maximum serviceability may obtain with a minimum expenditure of money.

The mechanical properties of pavements have been too little understood in the past, and the tests conducted by the University of Illinois, being the first performed upon this type of construction, are worthy of careful study. Tests in bending were performed upon four slabs built as follows:

No. 1. Three-inch brick were laid upon 4 inches of 1:2:4 concrete, upon the surface of which was spread a ⅛-inch layer of 1:5 dry mixture of sand and cement, to provide a smooth surface upon which to lay the brick. Joints between the brick were filled with 1:1 cement grout. The slab was allowed to harden for 24 hours and cured with damp sand for 27 days thereafter. Upon completion of the slab, the outside dimensions were 23 by 45 inches, with a total depth of 7 3/16 inches.

No. 2. Similar to No. 1, but 4-inch brick were used in place of 3-inch, as in No. 1.

No. 3. Four-inch brick were laid upon a 1-inch base of 1:3 dry mortar. The dimensions of the slab agreed with those of Nos. 1 and 2, excepting the total depth, which in this case was 5 inches.

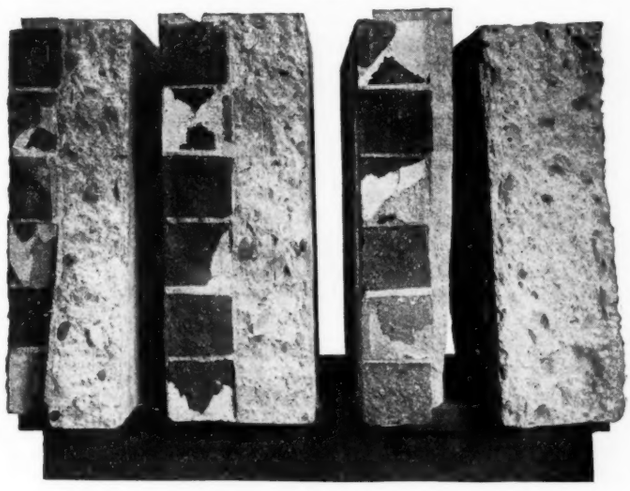
No. 4. This slab was constructed 7 inches thick, of plain concrete, intended to represent standard concrete pavement construction.

These slabs were tested in bending at an age of 28 days, with a 42-inch span, the load being applied upon the one-third points, with the following results:

Slab No.	Total Load.	Modulus of Rupture.
1	13,100	465
2	21,500	580
3	6,700	490
4	12,500	460

Comment on Tests.

Slab No. 1. As noted in the accompanying photograph, the fracture of the slab extended squarely thru the brick and concrete, in the first three rows of brick. For the remainder of the width there was a slight separation of the brick and concrete, evidenced by the different planes of fracture of the brick and concrete.



No. 1. No. 2. No. 3. No. 4.

Slab No. 2. This slab showed a square fracture thru the brick and concrete for the entire width of the slab. There was no separation of the brick and concrete.

Slab No. 3. This slab also showed a square fracture for the entire width.

General Conclusions.

While the number of tests was inadequate to furnish conclusive evidence, nevertheless certain conclusions may be drawn justifiably.

1. That it is possible to develop a sufficient bond between the brick and concrete to withstand all ordinary deflections of the pavement.

2. That altho there was no bond failure between the brick and concrete, there was a distinct line of demarkation between the concrete and the layer of sand and cement spread on the surface upon which the brick were laid. The tests served to show the desirability of increasing the richness of this dry mixture to at least a 1:3 in place of the 1:5 mix used.

These tests were performed at the University of Illinois, under the direction of C. C. Wiley, instructor in highway engineering, and are a portion of a series of tests being carried on in the same line of investigation.

Battle Tactics and the Paved Highway
Mobility Can Take the Place of Numbers Better than Numbers Can Replace Mobility

By P. S. Bond, Major, Corps of Engineers, U. S. Army; Member of the American Society of Civil Engineers.

The usefulness in war of a substantial system of highways can scarcely be overstated, but it can be misunderstood and frequently is. Our freedom from wars, during long periods, has made the term "military road" little more than an historical phrase in America. It calls to mind the Cumberland pike and suggests the conditions of military enterprise that gave rise to our constitutional provision for federal military roads.

Those conditions antedate the railroad. In the present state of affairs the longer hauls for the assembling of soldiers, munitions and supplies will almost invariably be made by rail. Military considerations do not call for long single lines of road thru the interior of the nation so much as for intensive systems of parallel and intersecting roads in the probable zones of actual warfare in case of attack by a foreign enemy.

To appreciate the tremendous usefulness of such road systems, it may be necessary to review some of the conditions of modern war as exemplified in Europe today. In speaking of innovations, I use the word with respect to popular American conceptions of war, which are still largely founded on the civil war of the sixties. The European war has really developed very few innovations, from the standpoint of the military student. Attacks by gas and liquid fire, effective as surprises, have been among these few. The general nature of the struggle was either anticipated by military men or actually demonstrated in the other wars of the last two decades. I wish particularly to refer to some phases of modern war with reference to the use of highways.

While less reliance than formerly is placed upon permanent fortifications, trench warfare between nearly equal forces tends to develop a condition of deadlock, in which the tactics are similar to those of a siege. Hence the routes of supply do not, under certain conditions, vary as much as in the old days of open fighting when one army would pursue another half across a continent on foot.

Not only are routes of distribution more permanent, but the volume and weight of the traffic is such as to justify and require the most substantial kind of highways. Larger armies eat more food. Larger and more intricate guns consume immensely more ammunition. The British army in Belgium is said to have fired more shells in a single day than were used in the entire Boer war. These are transported from the railroad terminals to the place of consumption very largely by motor truck and the effect on any but the most substantial roads can be imagined.

Add to these conditions the mobility now required for very heavy guns. It can be seen that the placing and replacing of ordinance weighing many tons per piece—the saving of guns in case of a sudden retreat—would be virtually impossible under the conditions that prevail on most American highways during long seasons, or would impose the heaviest possible tasks upon the engineering arm of the service.

We have pictures showing the kind of improvised roads upon which the resourceful Germans have been compelled to rely in Russia. They follow the principles of the old American corduroy road, with a foundation of stringers and transverse logs, on which are laid brush and dirt. The contrasting advantages of level durable road surfaces, prepared in time of peace with an eye to the exigencies of war, are so striking as to make comment unnecessary.

But the greatest advantage of motor trucks and suitable motor roads has yet to be mentioned. To appreciate it, one must bear in mind the broad nature of battle tactics. War is not unlike football. An army must hold the foe in check at all points on the line and relies for its success upon smashing attacks by the concentration of troops at some particular point. In the old days the plan of attack was often concealed from the enemy until the moment it was sprung. Distance and natural obstacles to vision made it possible to work out maneuvers with comparative leisure. Today the hostile aeroplane hovers overhead and conveys prompt information of the concentration of any considerable body of troops at any given quarter.

To render such an attack effective, it is therefore necessary to make it a sudden attack, like the dash of the backfield in a football game. To be able to move a whole division by truck and auto to a critical point at a rate of twenty or thirty miles an hour would greatly facilitate both offense and defence. It is said that the battle of the Marne was won by the sudden concentration of French troops, using motor transport over the splendid chaussees of France, upon the German left wing.

One road will not suffice for this variety of tactics, although one is better than none. The ideal would be a number of parallel routes traversing the line of battle, with frequent cross roads to permit the distribution of reinforcements at any desired point or points. In war, football or chess there is only one rule for success and that is to oppose a lesser force with a greater force at the crucial point in the conflict. This does not mean that the largest army always wins, for the largest army may have three quarters of its numbers out of action thru lack of general-ship or failure of transport facilities. Mobility can take the place of numbers much better than numbers can be made to take the place of mobility. When this fact is digested, the immense tactical value of paving can be better appreciated.

The motor can thus lessen the fatigue of forced marches and increase their possible radius five fold or more. It is also probable that motors will take over part of the work of transport formerly accomplished by rail. There is considerable necessary delay in entraining troops and getting a clear track for their movement, so much so that the old rule was to undertake movements of thirty miles or less on foot, as being prompter than train service. With suitable roads and an abundance of motor vehicles, this line of demarcation might be placed at sixty or a hundred miles or more, depending on the particular circumstances of the case.

The unimproved highway is our weakest link today from the standpoint of military transport. America has the railroads. It has the autos and auto trucks. Whether the latter can be used, or whether we must go back to the age of the mule whacker and the dreary march rests with those who are responsible for our highway improvements. Any city within a hundred miles of our coast or frontier may some day be the base of military operations that will put its surrounding highways to the severest test. Very few would meet it creditably. Cuyahoga County, surrounding Cleveland, would offer a better opportunity for modern maneuvers than any similar locality with which I am familiar. The brick road, properly constructed, stands high in the estimation of army men for such purposes as I have been describing.

In a military crisis such a system of roads would much more than pay for itself in the saving of other forms of military expenditure. Considering also how they conduce to the wealth of the nation in times of peace, there seems to be no possible argument against this phase of preparedness.

Records of Street and Road Repair

In a paper before the American Association for the Advancement of Science, Will P. Blair, secretary of the National Paving Brick Manufacturers' Association, makes a plea for the application of system to street management.

Mr. Blair carries the same idea into the taking of a traffic census and in a discussion of that subject before the American Society of Municipal Improvements he objected to the lack of information as to the exact character of the road for which a traffic census is taken.

If a traffic census is taken on a water-bound macadam road with no more information than may be inferred from the name, it is no guide to a correct conclusion as to the worth of water-bound macadam roads. The same is true with reference to all types of roads. The recorded information must give the most accurate and minute information as to exactly how it was built.

He cites brick roads which show very great depreciation in a comparatively short length of time, under little travel, and, on the other hand, brick roads from twenty to twenty-five years of age, bearing heavy traffic, that do not show any marked depreciation.

The same is true of measures of tractive resistance. A Medina stone pavement on one street offers extreme tractive resistance, yet it is not so old as another Medina stone street upon which the tractive resistance is apparently at a minimum.

Good Roads Notes

Oakland, Cal., holds the first Pacific coast motor power and automobile show in its new municipal auditorium April 26 to May 6. The show occupies 50,000 square feet of space. A large percentage of the net receipts will be used by the committee of the Oakland Chamber of Commerce on the Lincoln Highway to pay the expense of making that trunk line as far east as Salt Lake City. L. E. Warford, the special Pacific coast representative of the Lincoln Highway Association, is secretary of the show.

Altho no roads have been constructed in Alaska as yet which are considered good enough to be called automobile routes, the 901 miles of wagon roads which the U. S. Government has built at an average cost of 3,000 a mile, are used by many automobile stages, trucks and smaller vehicles and the saving in cost of transportation in one year, over the former roadless condition was over $2,000,000, or a saving in one year of two-thirds the total cost of roads, winter sled roads and trails since 1906.

MISCELLANEOUS

The March of Events

May 8-10, at Waco, Tex., Southwestern Water Works Association. E. L. Fulkerson, secretary, Waco, Tex.

May 9-11, in auditorium of Insurance Exchange, Jackson boulevard and LaSalle street, Chicago, National Fire Protection Association. Headquarters at LaSalle Hotel. Franklin H. Wentworth, secretary, 87 Milk street, Boston, Mass.

May 10-17, at Indianapolis, Ind., National Conference of Charities and Corrections. W. T. Cross, general secretary, 315 Plymouth Court, Chicago, Ill.

May 16-19, at New York, National District Heating Association. D. L. Haskill, secretary, Greenville, O.

May 17-20, at Galveston, Tex., Southwestern Electrical and Gas Association. H. S. Cooper, secretary, Slaughter building, Dallas, Tex.

May 22-26, at Congress Hotel, Chicago, Ill., National Electric Light Association and Electric Vehicle Association of America. A. Jackson Marshall, secretary, E. V. A. A.; T. C. Martin, secretary N. E. L. A., 29 West 39th street, New York.

May 31-June 2, at Syracuse, N. Y., New York State Conference of Mayors. W. P. Capes, secretary, New York City.

June 5-7, at Cleveland, O., National Conference on City Planning. Flavel Shurtleff, secretary, 19 Congress street, Boston, Mass.

June 5-9, at New York, American Water Works Association. J. M. Diven, secretary, 47 State street, New York.

June 25-30, at the University of Pennsylvania, Philadelphia, Pa., The Associated Advertising Clubs of the World. C. A. Clark, secretary.

June 27-30, at Pittsburg, Pa., American Society of Civil Engineers. Charles Warren Hunt, secretary, 220 West 57th street, New York.

June 27-July 1, at Atlantic City, N. J., American Society for Testing Materials. Edgar Marburg, secretary, University of Pennsylvania, Philadelphia, Pa.

Oct. 9-13, at Robert Treat Hotel, Newark, N. J., American Society of Municipal Improvements. Charles Carroll Brown, secretary, 702 Wulsin buildings, Indianapolis, Ind.

Feb. 5, 1917, at Mechanics' Hall, Boston, Mass., American Road Builders' Association meeting, road congress and good roads show. E. L. Powers, secretary, New York.

Engineering Co-operation

The conference of the committee on engineering co-operation in Chicago, April 13 and 14, spent its time in exchanging reports of the problems and successes of the forty-two societies directly or indirectly represented and asked Prof. F. H. Newell and a sub-committee to formulate a plan for promoting co-operation of the engineering societies on general matters of advantage to the profession at large or in its various branches. The plan is to include national, state and local organizations and local branches of national organizations.

Municipal Auditorium for St. Louis

As a part of the expense of the Shakespearean Tercentenary Celebration, to be held June 5 to 11, the St. Louis Pageant Drama Association has constructed in one of the city parks an outdoor auditorium which will be turned over to the city without cost to it and will afterwards be available for any form of wholesome entertainment for which no admission fee is charged.

Chicago Engineers Inaugurate Preparedness Campaign

A group of prominent engineers and contractors of Chicago and vicinity have co-operated in forming a Joint Committee on Military Engineering. The founders are members of all the leading engineering and contracting organizations of Chicago, including the local branches of the national engineering societies.

The purposes of the committee are to further military preparedess among engineers, contractors and their associates by the following means:

1—Courses of lectures.
2—Assigned reading.
3—Studies and practical instruction in military engineering.
4—Assisting engineers to qualify as officers in the National Reserve Corps of Civilian Engineers.
5—Urging enlistment in and support for engineer troops of the National Guard and such other organizations as the Government may create.
6—Furthering instruction in military engineering in training camps and the attendance in them of those qualified.
7—By such other means as from time to time may be deemed advisable.

The Joint Committee has already prepared a program covering the vital points outlined. The program is practically complete for a period extending from April 20 to July 25. Something of interest will be taken up each week, including lectures by Lieutenant-Colonel W. B. Judson, Engineer Corps, U. S. Army; two lectures by Major P. S. Bond, Engineer Corps, U. S. Army; Lieutenant-Colonel Mason M. Patrick, Engineer Corps, U. S. Army, and several exhibition drills, terrain exercises and inspection trips under the direction and guidance of various officers of the engineer troops of the Illinois Na-

tional Guard. Additions to the program will be made from time to time.

Engineers, contractors and their associates in Chicago and vicinity are invited to join the Joint Committee on Military Engineering. Correspondence should be addressed to the secretary, Robt. F. Hall, 111 West Washington street, Chicago.

Personal Journalism in Advertising

E. C. Tibbitts, the only advertising manager The B. F. Goodrich Company, of Akron, O., has ever had, has just concluded his nineteenth year in that capacity. He has no one with whom to divide the responsibility and the credit for the peculiarly effective advertising for which his company has become famous, and it is fitting, therefore, that a touch of the old-fashioned personal journalism should be given by putting his name to the front as the man who has put his impress upon the Goodrich business from the publicity side. He could not have succeeded without high-grade products behind him, and the Goodrich products, from the bottle nipples to Silvertown tires, are of the best. But these good products could not have reached their present popularity without correspondingly good publicity, and for this Mr. Tibbitts is alone responsible.

Septic Tank Patents

The National Septic Process Protection League has been organized with Dr. H. M. Bracken, executive officer of the State Board of Health, St. Paul, Minn., as president; A. E. Kimberly, consulting sanitary engineer, Columbus, O., as vice president, and Frank G. Pierce, secretary of the League of Iowa Municipalities, Marshalltown, Iowa, as secretary-treasurer. The executive committee includes Dean A. Marston, of the engineering department of Iowa State College, Ames, Iowa; C. A. Haskins, engineer of the State Board of Health, Lawrence, Kans.; Paul Hausen, engineer of the State Board of Health, Springfield, Ill.; Wm. J. Locke, secretary of the League of California Municipalities, San Francisco, Cal., and W. P. Capes, secretary of the New York conference of mayors, Albany, N. Y.

The purpose of the league is stated in its constitution to be "to give legal advice an ddefend any suits brought by the Cameron Septic Tank Company against any municipality, company, corporation, state institution or private individual which is a member of this league, when such suit involves the validity of any patent claimed by such company." Assessments for expenses range from $5 for a private individual to $35 for a city of more than 50,000 population, and no assessment except the first can be made without the approval of three-fourths of all the directors, of which there are two from each state.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

May 9: Valuation analyst, under Interstate Commerce Commission for work mainly in Washington. First grade, $3,600 to $5,000 a year; second grade, $1,800 to $3,200 a year.

May 17, 18: Heating and ventilating engineer and draftsman in office of the Supervising Architect, Treasury Department, Washington, D. C., at $1,200 a year.

Personal Notes

R. T. Stull, ceramic engineer of the Dunn Wire-Cut Lug Brick Company, of Conneaut, O., was elected an honorary member of the Paving Brick Institute at the recent meeting at Portsmouth, O.

Frank Koester, consulting engineer, 50 Church street, New York, has recently completed a report and plans for the systematic development of the city of Allentown, Pa.

Alexander C. Brown, vice president of the Brown Hoisting Machinery Co., Cleveland, O., has been appointed general manager.

Charles P. Light, for some years field secretary of the American Highway Associatin on May 1, associates himself with the Fidelity Mutual Life Life Insurance Co., of Philadelphia, as a manager with offices at 1423 G street, N. W., Washington, D. C.

Rankin Duval has been appointed road engineer of Scott county ,Ky., with headquarters at Georgetown. The county has voted $100,000 bonds for road construction.

Hansen and Coulter is the style of a new, firm of hydraulic and sanitary engineers at 2 Rector street, New York. Mr. Hansen has had some twelve or fifteen years of varied and valuable experience in water and sewerage and house drainage and plumbing, and Mr. Coulter has had about fifteen years' experience in the same lines, including three years on trades wastes disposal.

F. H. Shaw, in addition to his office at Lancaster, Pa., has opened an office at 2307 Woolworth building, New York. Mr. Shaw designs and constructs water, gas, sewerage, railway and hydro-electric installations.

John R. Graham is the new commissioner of streets of Lynn, Mass., having been promoted from general foreman on the death of his predecessor.

Geo. W. White is county surveyor and road engineer of Jefferson.

B. C. Brenner is re-elected city engineer of Kenosha, Wis., for the fourth time.

James Allen is the new State Highway Commissioner of Washington, at Olympia, and Geo. F. Cotherill the new chief engineer.

W. L. Benham is the new city engineer of Blackwell, Okla.

Chester E. Albright is the new chief engineer of the Bureau of Surveys in the Department of Public Works of Philadelphia, Pa.

Frank P. Cobb is city engineer of Chicopee, Mass.

Philip W. Henry, consulting engineer, New York, has been elected vice president of the new American International Corporation to develop American foreign trade. His engineering and business experience in this and other countries fits him exceptionally for this application of his eminent abilities.

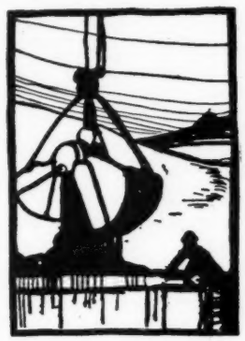
C. R. Sumner is city engineer of Hermosa Beach, Cal.

G. W. Cunard is city engineer of Port Angeles, Wash.

H. O. Swoboda, consulting electrical and mechanical engineer, Empire building, Pittsburg, Pa., has been employed by the Boro of New Brighton, Pa., as consulting engineer to plan a new street lighting system.

Col. J. W. Howard, consulting engineer for roads and pavements, New York City, has dropped his suit for slander against Chief Engineer Morris R. Sherrerd, of the Newark, N. J., Department of Public Works, arising out of the controversy about the Market street wood block pavement some eighteen months ago, Mr. Sherrerd having disclaimed any intention of injuring Mr. Howard by any statements he actually made and having asserted the inaccuracy of the newspaper reports of his statements.

L. D. Beckley has opened an office at 2931 Woodward avenue, Highland Park, Mich., a suburb of Detroit, for the practice of general engineering work, paying special attention to municipal improvements and surveys.



MACHINERY AND SUPPLIES

New "P & H" Corduroy Back-Filler

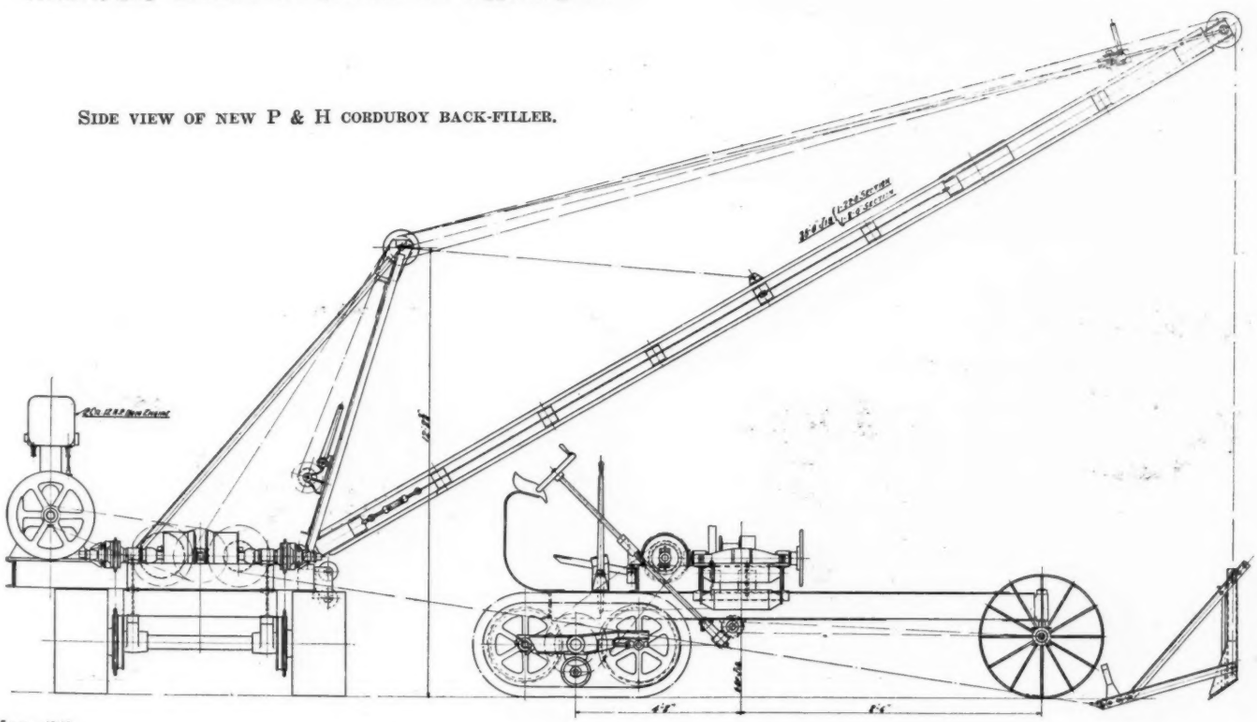
By J. D. Rankin, C. E.

We are showing general arrangement tracing of late type of "P. & H." corduroy-grip-type back-filler, recently made for a firm of prominent Chicago contractors. This machine, which possesses all of the advantages of corduroy traction, is especially suitable for use on mucky footing. It is of the drag-line-excavator type and is designed to backfill all ditches ordinarily cut with trench excavators for water, gas or sewers. All gears are made either of steel forgings or of the best semi-steel castings. All spur gears and pinions have teeth cut from the solid. All bearings are lined with the best babbitt metal and all clutches are friction clutches of the internal expanding ring type lines with asbestos clutch lining.

The front or steering wheels are 42 inches diameter by 12 inches face with plate steel tires and steel spokes cast into heavy iron hubs. The axle is composed of two 6-inch channels, between which are bolted the 2⅜-inch diameter wheel journals, which are readily removable if necessary on account of wear or for other reasons. The axle is pivoted both vertically and horizontally, providing a 3-point support for the car body and preventing distortion of the structure when passing over uneven ground.

Corduroy-grip tractions are provided for supporting the rear of the machine. These tractions are each 18 inches wide by approximately 36 inches between center lines of end sprocket shafts. They are driven by means of chains from the propelling shaft. The two driving sprockets are equipped with slip frictions, either of which can be thrown out of engagement when maneuvering in confined spaces. The main frames of the corduroys are steel castings independently pivoted on the rear axle so that they will accommodate themselves to inequalities in the ground without straining the car body. The traction chains are made of steel casting links with hardened forged steel pins. The supporting blocks are of hardwood, fitted on their upper surface with steel plates. The pressure between the supporting blocks and main frame is taken by the steel casting end sprockets and by a pair of chilled iron intermediate rollers. The general design of tractions is such that they can easily be dismantled for repairs.

The main machinery consists of one intermediate shaft, chain-connected to the engine, and two drum shafts, gear connected to the intermediate shaft. The pinion on the intermediate shaft is a steel forging with teeth cut from the solid. The gears on the drum shafts are of semi-steel also with teeth cut from the solid. The drums run loose upon the shafts and are connected thereto by means of internal-expanding-ring-type clutches 15 inches diameter by 2½ inches face, lined with as-

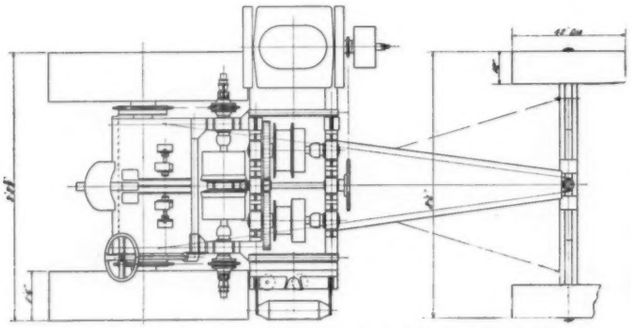


SIDE VIEW OF NEW P & H CORDUROY BACK-FILLER.

bestos clutch lining. The drum for the pulling rope is 10 inches diameter. The drum for the hauling rope is 15 inches diameter. Both ropes are ½ inch diameter. The intermediate shaft is connected to the engine by means of a high-speed roller chain of 1¼ pitch. An internal-expanding-ring clutch is provided on the engine shaft, enabling all machinery to be placed out of action and the engine to be started without a load.

A steel bevel pinion on the end of the intermediate shaft is provided, meshing with two semi-steel bevel gears on the propelling shaft. These gears are provided with internal-expanding-ring asbestos-lined friction clutches, by means of which propelling motion is obtained in either direction. The connection between this shaft and corduroys is as hereinbefore mentioned. The propelling speed is approximately 1 2/10 miles per hour.

The steering machinery is mounted under the car body and



HORIZONTAL SECTION OF NEW P & H CORDUROY BACK-FILLER.

is operated by a worm and worm wheel, which are self-locking. Connection between this shaft and the front axle is by means of chains. Cushion springs are provided to check the shocks occasioned by obstructions in the road. The steering shaft is hand operated, a large hand wheel, with handle being provided for this purpose.

The operating levers are located at the rear of the machine and so grouped that they can all be reached from one position.

A jib 22 feet long with 8-foot extension, making a total length of 30 feet, is provided. This jib is built up of timber construction and is arranged to swivel approximately 4 feet on either side of the center line. This allows the scraper to be moved to this extent without moving the machine. Adjustment for the jib is obtained by means of a hand winch mounted on the uprights of the car body.

A self-acting scraper 4 feet wide and built up of steel plate, angles and oak planks, is provided for handling the dirt. The design of this scraper is such that no men are necessary to guide it when at work.

This machine, which is manufactured by the Pawling & Harnischfeger Co., Milwaukee, Wis., is driven by a 12-h.p. 2-cylinder vertical hopper-cooled engine, running at 400 r.p.m., provided with a friction clutch of the internal-expansion-ring type and connected to the machinery by means of a high-speed roller chain, as hereinbefore specified. The fuel tank is located in the base of the engine, pump being provided to deliver the fuel to the mixer. The engine is provided with an efficient governor for regulating its speed.

The general dimensions are as follows:

Out to out of corduroys	8 feet, 2½ inches
Wheel base	13 feet, 2 inches
Height without jib	13 feet, 1 inch
Weight, in working order, approximately	14,500 pounds

Gardner Portable Air Compressor

We are illustrating one of the Gardner portable air compressor outfits operating calking tools on one of the city water mains, Sacramento and Avondale Avenues, Chicago. This work was done by day labor of the Bureau of Engineering, Division of Water Works Extension, City of Chicago.

These plants, as illustrated, are equipped with enclosed self-oiling compressors, having separate water cooling system to that of the engine. Are very simple and require but little attention to keep them in good working condition. The entire freedom from intricate mechanisms, requiring delicate adjustments, makes them especially valuable for use in places where best care and attention are not always available. The air tanks are of ample proportions and allow of a large storage of air.

The gasoline engine is of the 4-cylinder, 4-cycle, long-stroke, vertical, heavy-duty type, specially designed for portable compressor work, and is guaranteed to stand up under the hard work that air compressor service requires. Complete with carburetor, magneto, etc. The speed is controlled by fly-ball-type governor, which is adjustable when running or idle, and can be sealed to prevent tampering.

The jackets of the cylinders are kept cool by specially designed radiator, or cooling tower. A safety starting coupling is provided to enable the operator to start the engine easily and to eliminate the much feared back kick. In addition to five large main bearings an outboard bearing is provided to take care of any strain that may come on the bearing when compressor unloader cuts in instantaneously against the full load.

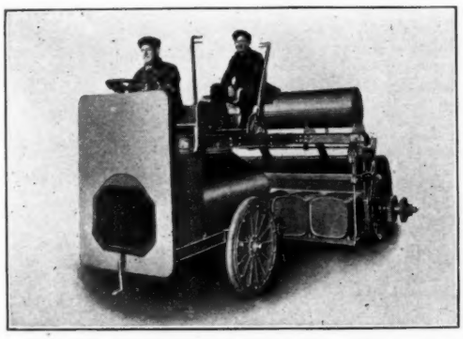
The compressors illustrated were built by The Gardner Governor Co., Quincy, Ill.

GARDNER PORTABLE AIR COMPRESSOR ON CHICAGO CALKING JOB.

Motor Pick-Up Sweeper

We are illustrating a recent type of motor-driven pick-up sweeper as perfected by the Baker Mfg. Co., Springfield, Ill.

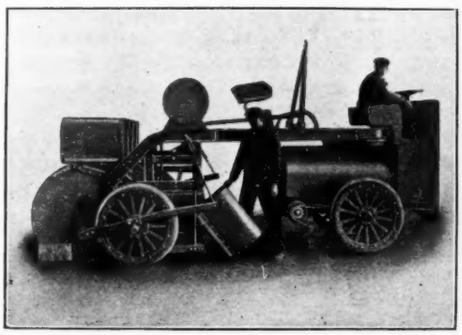
It will be noted that there is room enough in the two carrying racks of the sweeper for eight extra half-yard cans besides the four cans which are furnished with the machine. The helper removes the cans when filled, replaces them with empty ones, puts filled ones in place of empty ones on the rack



until all are filled; then the sweeper carries the picked up litter to a convenient transfer station. The cans are either emptied on the dumping ground or into waiting wagons.

The width swept is 7 feet. Thus, a 25-foot street requires but four trips from gutter to gutter. Since this motor will operate from 18 to 20 miles on a gallon of gasoline, you can easily figure how cheap its operation will be per mile of streets.

This outfit is driven by a 4-cyl., 30-h.p. motor. The machine over all measures 17 feet in length, 10 feet in width and is 6 feet 7 inches high.



New Type of Excavator

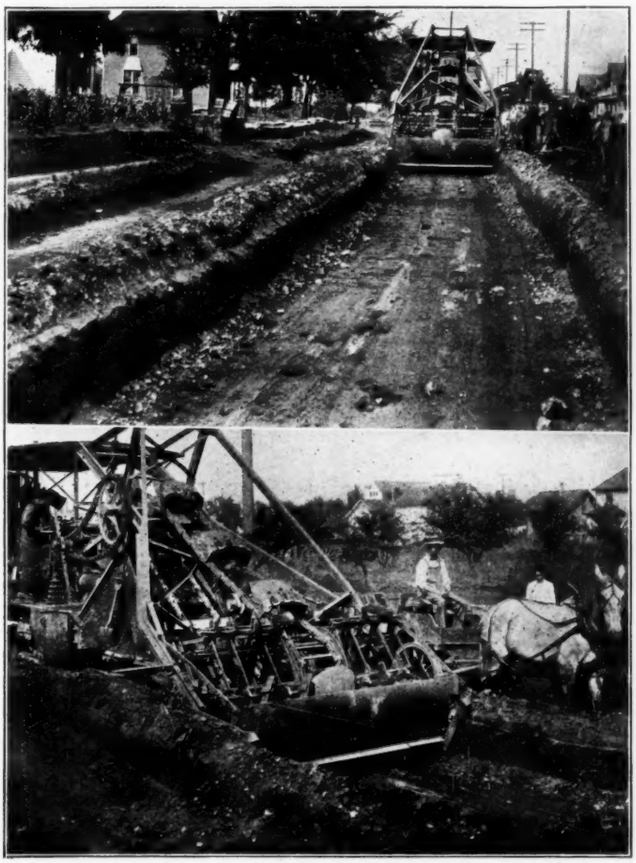
Last season, 1914, the General Engineering and Construction Co., of Rockford, Ill., subcontractors for municipal street work, perfected a new type of grading and excavating machine, which seems to meet in a very practical way, certain conditions in street excavation, not met by any other machine.

This machine is particularly adapted to grading in connection with street paving work, especially where it is desirable or necessary to haul the dirt in dump wagons and where space is limited as in many points.

It is also adapted to excavating trench for street railway tracks. This machine cuts a strip 8½ feet wide, and will excavate 2 or 3 inches deep, or as deep as 5½ feet, the cutting wheel working on a boom being instantly adjustable by a screw raising or lowering. An indicator is provided so that the operator can run true to a grade line. The earth is deposited in dump wagons and the production is so uniform that the number of teams can each day be properly proportioned to the length of haul, so that there will not be over half a minute lost team time at the machine on each trip. This is one of the points of economy in using the machine.

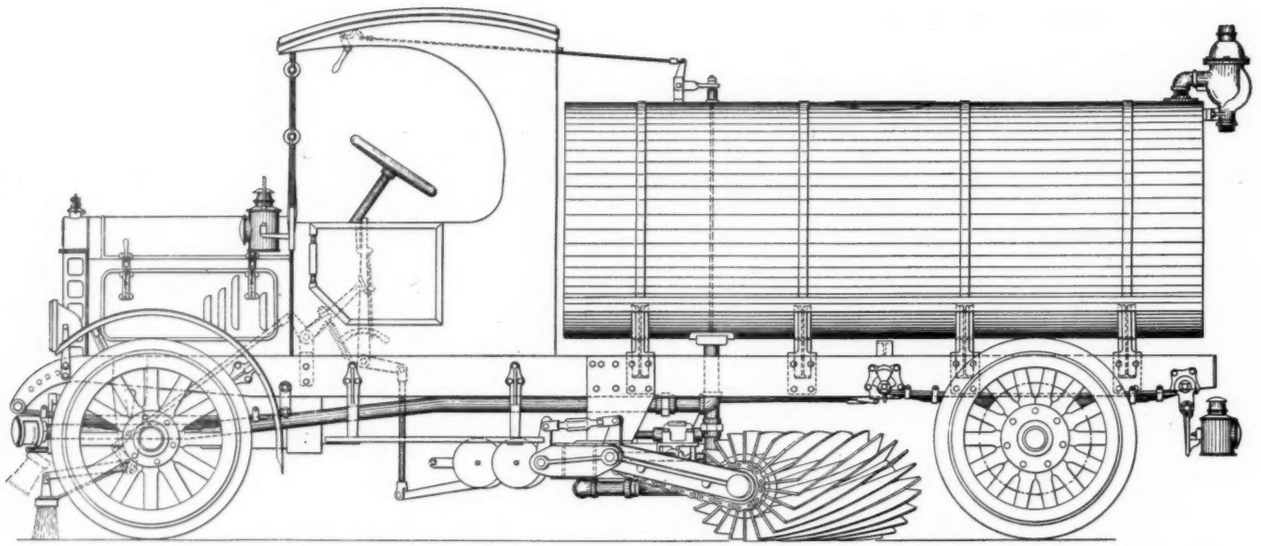
This machine can be run so as to cut very close to a finished fine grade, saving a considerable amount of expensive hand work. In practice, it is found best to make the outside cuts on street work first, cutting to a line to allow room for the curb and gutter and the forms. On the outside cuts the excavator is pitched to conform to the crown of the street. If the width of the excavation should be 25½ feet, there would be two outside cuts, one cut in the center with nothing left, and the third and middle cut made flat. If the width of the excavation was less than 25½ feet, the result would be the same.

If the width of the excavation was 27½ feet, for instance, there would apparently be 2 feet of the side which could not be handled thru the machine. However, this extra material is taken care of by making the center cut as before, and sufficiently deep so that the one foot of surplus material on each side of this cut, can be leveled down and rolled into the center cut.



In practice it has been found desirable to cut slightly below the finished subgrade and at the last cut to finish the fine grade at once, by dumping sufficient material from the wagons to level it up to the desired grade and roll at once. Obviously, this is much less work than making a fine grade by removing surface by hand tools.

Material at alley intersections is taken care of by excavating deeper in front of the intersection for 16 to 24 feet, thereafter to plow the intersection and slip the earth into the extra depth. This machine will work on old macadam streets if the excavation can be made two inches. It is seldom necessary to root or ploy the streets in advance of the machine, as the cutting drum is provided with narrow sharp cutting teeth. This machine will also handle sand as well as fine material.



In street railway track excavation, the track trench is usually 18 to 20 inches deep and 8½ feet wide. This cut is made in one operation and the spoil put in wagons. If it is railway track work, the track may be removed closely ahead of the machine by jacks, and the trench being completed, new track can be laid directly in back of the machine, so that in case of single track work, the cars can be kept running with only a break and transfer of 150 to 200 feet. About 500 linear feet of track trench can be handled per day of ten hours.

These machines have been run on work, both paving and street railway, in Illinois in 1914 and 1915, and have proved satisfactory and practical in every case.

Sterling-Kindling Motor Squeegee

The Kindling Machinery Company, Milwaukee, are marketing a motor-driven outfit as described in the March issue of MUNICIPAL ENGINEERING.

The Kindling rubber rotary squeegee, of familiar use on horse-drawn tank wagons, is shown by the accompanying cut combined with a Sterling chassis carrying a 1,000-gallon tank. The essential features of the motor squeegee are described as follows:

Placed immediately in front of the front fenders of the chassis are two flusher nozzles controlled by the driver by a lever from his seat. The flusher nozzles, by sprinkling the surface of the street, prevent the agitation of dust, and also dampen the attached matter, so that the squeegee roller can easily force it loose from the pavement and wash the surface clean. Supplementing the function of the nozzles in loosening the attached matter and to prevent the squeegee from being compelled to handle too large a mass of material, a pair of heavy pavement sweeping brooms are fitted immediately behind the front nozzles, the purpose of which is to force aside the large refuse so that it will become suspended in the water, leaving the squeegee to wash up the tightly adhered material by frictional action. Mounted near the center of the chassis frame and immediately underneath is a squeegee or spiral-shaped roller of 19 inches diameter and 8 feet long. Each individual, specially-treated rubber spiral is firmly set, but easily detachable, and mounted in a special kiln-dried wood holder of large wearing surface. And, being adjustable as they wear, more fresh surface of the squeegee can be brought into engagement with the street. The squeegee attachment is flexibly mounted and counterbalanced in such a way that when adjusted to a certain pressure it is impossible for the roller to work loose and the pressure against the surface of the street is uniform, the rubber strips being 6 inches deep, affording large wearing surface. A toggle-joint linkage, terminating in a lever in the driver's cab, enables him to easily and quickly place the squeegee attachment in and out of engagement with the street, and, when returning from washing a section of street, to lift the roller out of contact with the pavement.

The tank is fitted with a water meter which indicates the amount of water flowing thru it. The water meter serves not only as a safeguard against the squeegee operator's idling and claiming to have squeegeed more street surface than he has, but gives data for calculating the water consumption per square yard for different kinds of pavements, under different conditions, etc. The tank contains four valves near the front end for distributing water to the front and to the side nozzles near the squeegee roller.

The manufacturers of the motor squeegee described are the Sterling Motor Truck Company, Milwaukee, Wis.

Use of Automatic Buckets

Figs. 1 and 2 illustrate two Hayward buckets as used in public construction.

Fig. 1 bucket is in operation on the southern outfall sewer, Louisville, Ky. Work done by the Blackstaff Engineering Company. The section upon which this picture was taken is

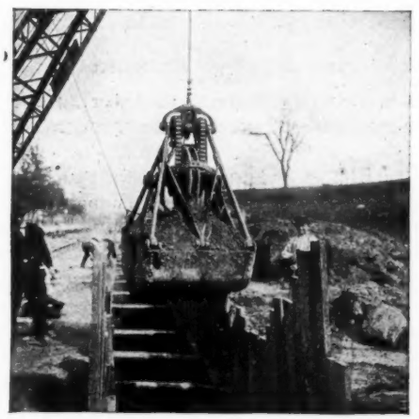


FIG. 1. SEWER TRENCHES MAY BE EXCAVATED WITH HAYWARD BUCKETS AND THE MATERIAL LOADED DIRECTLY INTO WAGONS, WITHOUT THE AID OF A HOPPER. THE ILLUSTRATION SHOWS A TRAVELING DERRICK OPERATING IN THIS WAY.

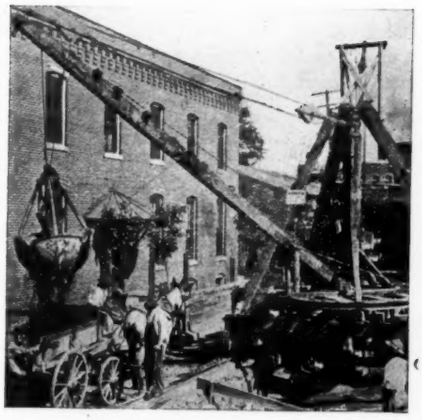


FIG. 2. HAYWARD BUCKETS ON SEWER WORK. WITH THE TRENCH MEASURING 6 FEET WIDE AND THE SPACE BETWEEN AVERAGING 10 FEET, THIS 1½-CUBIC-YARD BUCKET DUG ALL GRADES OF SAND, LOAM AND GRAVEL.

about 4,000 feet long, consisting of a junction chamber connecting the 7-foot 8-inch sewer to a 12-foot sewer, a branch sewer 10 feet in diameter and 150 feet long, and a long stretch of main sewer 7 feet 8 inches and 7 feet wide. Most of the work is being carried on in open cut, the excavating being made with a Hayward orange peel bucket, operated by a traveling derrick, which is supported across the excavation in such a manner as to take up the least possible amount of street width. The depth of cut varies from 25 to 28 feet.

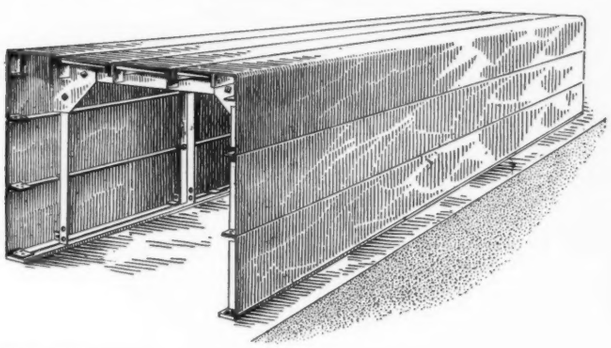
The location is in the center of a street paved with brick, in a part of the city well built up, mostly in the residence district. The upper 10 or 12 feet of earth is clay or loam, beneath which is coarse sand, with some gravel in it, the combination presenting great difficulties in properly sheeting and bracing so as to avoid damage to the street and surrounding buildings.

Fig. 2 shows bucket operating on a 48-inch city water main, Bay Ridge, boro of Brooklyn, N. Y. F. V. Smith Contracting Company. Trench, 6 feet across; bucket, 1½ cubic yards; Class H clam shell, with ore bowl, fitted with teeth; operated by a Brown hoist crane. Spacing between struts, about 10 to 12 feet; average depth of cut, 10 feet. Material, all grades of sand, loam and gravel.

Adjustable Rectangular Culvert Form

We are illustrating a popular type of Blaw adjustable rectangular culvert form.

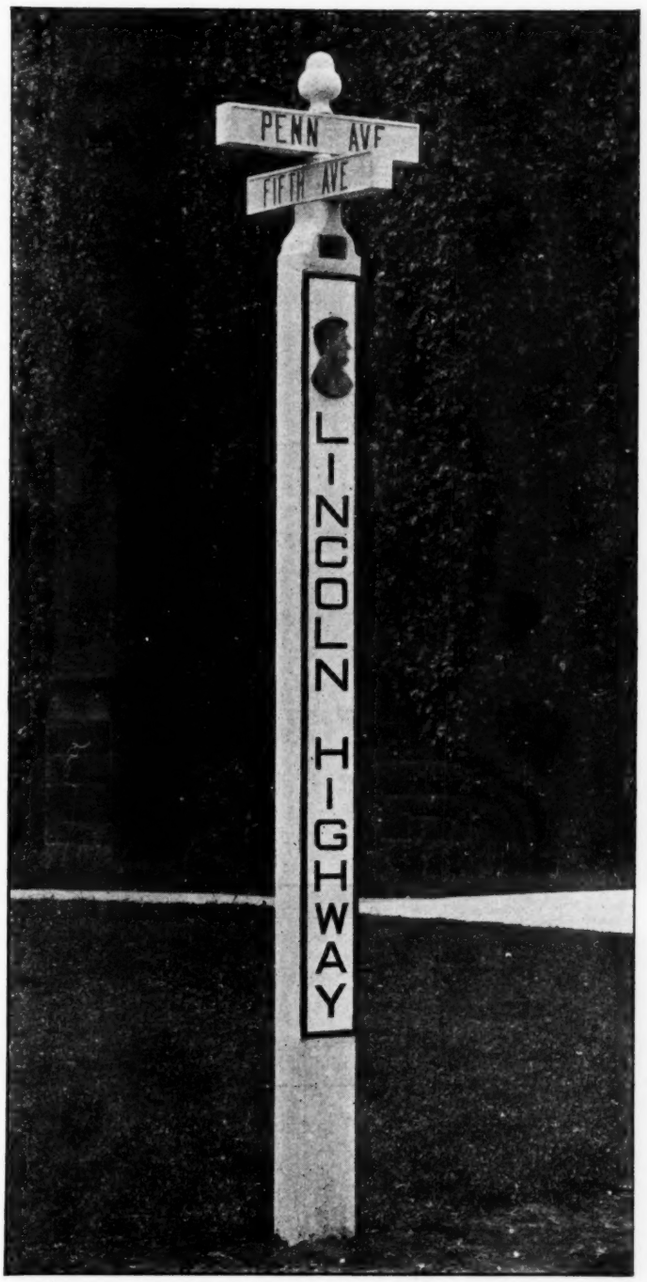
The sections are in 5 and 10-foot lengths, made up in sets adjustable from 2-foot height by 3-foot width up to 5-foot height by 6-foot width, with any 12-inch adjustment. They are composed of plates 12 inches high and 12 by 12-inch bracketed corners, with brace angles in the interior, which support the sides and roof. A small number of hook bolts are used to connect the roof panels and the side panels to the supporting interior angles thru the outstanding flanges of the panels themselves. They draw the entire form together, are very easily inserted in place, and are a permanent part of the interior supporting angles.



Concrete for the base or floor of the culvert is first placed. Boards 1 inch by 4 inches are then laid along the sides of the base. The mold is put in position on top of these boards. After the concrete has set, the board is withdrawn, being easily slipped out from under the form. The hook bolts are turned around and released, the roof is removed all in one piece, and each complete side piece is removed.

Reinforced Concrete Posts

The introduction of concrete into all lines of construction work has given rise to numerous specialties, covering many fields of operation. An original and practical use has been ap-



plied to concrete in the manufacturing of National reinforced concrete-lettered signs and posts. These products are made from white, stainless portland cement and crushed granite, molded by a special process, which produces a hard, smooth surface, unstainable and permanently unaffected by weather conditions. The letters are molded in a plastic state and dovetailed into the body of the concrete, making the whole work a monolithic structure.

In the accompanying illustration there is shown a combination lamp post and street marker which has been installed in the city of Pittsburg, where it serves to designate the Lincoln Highway. This post is made of concrete and has a 6-inch face and 5-inch side; the total height from ground level to the bottom of the first sign is 8 feet; the post is set 3 feet in the ground. Connections have been provided for future use, both for gas and electric light.

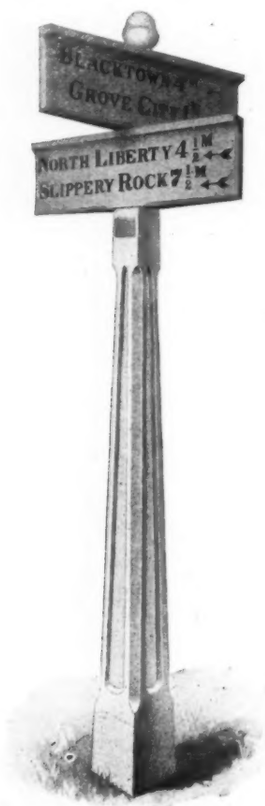
Both the letters and the bas-relief of Lincoln on the face of the post are blue on a white ground. The post is faced with a portland cement mixture, and the inlay letters are tinted to produce the desired color effect. The border, shown as a black line on the illustration, is a concrete mixture colored red. The letters of the street signs are black.

These products are made by the National Concrete Sign and Post Company, Inc., Oil City, Pa.

Concrete Street Signs

W. H. Filer, Grove City, Pa., manufacturer of artistic concrete products, offers a very novel specialty in guide posts, consisting of a reinforced concrete standard, with concrete boards, as shown in cut.

The posts are ornamental in design, having beveled edges and sunken panels. The concrete inscription boards are neatly made, and letters are of cement, in black and other colors, ¼ to ½ inch in thickness, dovetailed in the body of the work, and as they are non-fading, the signs are indestructible and everlasting.



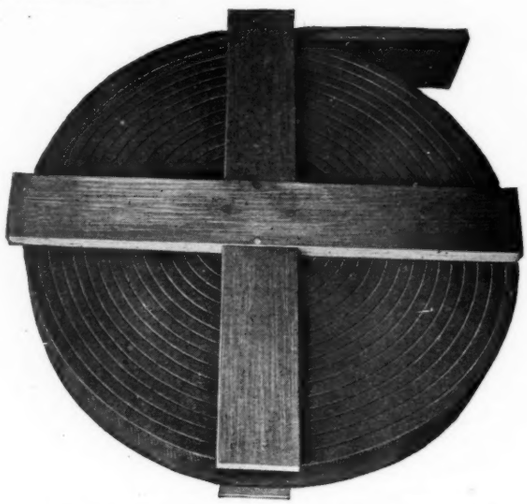
CONCRETE SIGN AND STANDARD.

These posts and signs are made of granite and Medusa white portland cement, and photographs cannot emphasize the beauty and clearness of the product. Mr. Filer states that "the best material adapted for this work that I can find is Medusa white portland cement."

A New Expansion Joint, Made by the "Fiber Weld" Process

A new material for the expansion joints of concrete, brick or block pavements is now being offered by The Barrett Company.

It is a mastic which comes ready to lay, in ribbon form, in a variety of widths and thicknesses. It contains no felt or paper reinforcement.



"BARRETT'S NEW FIBER-WELD-PROCESS EXPANSION JOINT"

A new process, known as the "Fiber Weld" process, gives to the bituminous mastic the requisite cohesiveness to stand handling and storage in the ribbon form, without affecting the elasticity that is necessary for expansion requirements.

It seems to possess all the elasticity of a poured bituminous joint with all the advantages of easy handling.

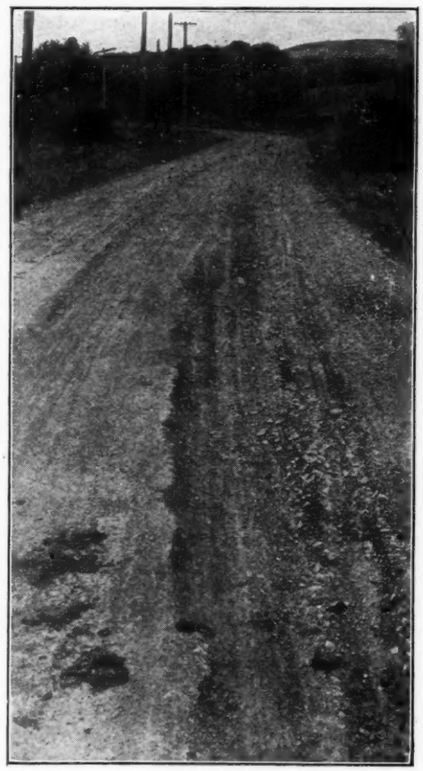
The material is waterproof and weatherproof and is not injured by street acids or automobile oils. It does not become brittle with age or cold weather and does not soften or run in hot weather.

Its chief advantage over the usual poured bituminous joint is the elimination of heating or pouring apparatus and a great reduction of the labor item—as it takes only a moment to un roll the joint and cut and put it in place.

It will be marketed under the name of "Barrett's Expansion Joint."

The Road Builder's Guide

A complete guide for the road builder to grading, rock-crushing and road surfacing equipment is issued by the Austin-Western Road Machinery Co., of Chicago. One of the companies to which the present corporation is the successor was the Western Wheeled Scraper Co., which, in its wheeled scraper entered the market with the first piece of improved machinery. Since that time that company and the Austin Mfg. Co., and their successor, the present company, have been in the forefront of the development of road machinery and the publication referred to shows the results of their exterprise and it is what it purports to be a complete guide to modern road building apparatus, including road graders and reversible road machines of various designs to suit any kind of work



Forest Lawn Road, Florence, Neb., showing condition of road before the use of "Tarvia-X"

Before and after——

BEFORE this road was tarviated it was difficult to keep the surface in decent condition on account of the automobile traffic. The swift thrust of automobile driving wheels disintegrated the surface and the expense of maintaining the road in good repair was large.

When it was resurfaced in June, 1915, the road was bonded with "Tarvia-X".

The Tarvia forms a tough, plastic matrix about the stone, cementing it into a concrete. Automobile wheels instead of destroying the surface will compact it and help to preserve it.

Tarvia
Preserves Roads
Prevents Dust

The use of the Tarvia added a little to the cost of the resurfacing of the road, but this will soon be repaid in the *reduced cost of maintenance.* This road service is waterproof and develops no dust or mud.

Scores of communities now are using Tarvia regularly year after year simply for the sake of keeping down road expenses. There are three kinds of Tarvia and a dozen ways of using them to meet various road problems.

Booklets on request. Address our nearest office.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems.

The advice of these men may be had for the asking by anyone interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

The Barrett Company

TRADE B MARK

New York Chicago Philadelphia Boston St. Louis
Cleveland Cincinnati Pittsburgh Detroit Birmingham
Kansas City Minneapolis Salt Lake City Seattle Peoria

The Paterson Manufacturing Co., Limited: Montreal Toronto Winnipeg Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

Forest Lawn Road, showing transformation of road surface after the use of "Tarvia-X"

required, road rippers, scarifiers, road planers and finishers, portable rock crushers, portable rock screens and bins, conveyors, motor road rollers, elevating graders, dump wagons, stone-spreading wagons, street sweepers, combined sprinklers and sweepers, street sprinklers, pressure road oilers, horse rollers, dump cars, road drags, wheel and drag scrapers and plows, all of which are fully described and their uses illustrated. The book also describes a motor lawn mower which looks interesting.

Any grade of machinery needed for any kind of road work can be selected from the full information given. The book will be sent on request.

Trade Notes

Cleveland Tile Hook Co., Cleveland, O., have a hook for handling building and conduit tiles which should be very popular.

Two 360-b.h.p. 4-cylinder oil engines have been installed by the Bolinders Company, of Stockholm and New York, for the Watson Flagg Engineering Co., Perth Amboy, N. J., where they run direct-connected to General Electric Co.'s 60-cycle alternators in parallel by means of Bolinder's special synchronizing device.

"Saving Cents and Losing Dollars" is the title of a little circular of the Studebaker Corporation, South Bend, Ind., on dump wagons.

The Coldwell combination roller and motor lawn-mower seems to meet the large demands for the work it can do to the full satisfaction of their users in parks, golf clubs and private grounds in all parts of the country.

The National Motion Pictures Co., Indianapolis, Ind., have produced, in collaboration with the National Fire Protection Association of Boston, a moving picture film about 1,000 feet long, showing various methods in which fires start and the results of carelessness and neglect of regulations.

The Indiana Paving Brick & Block Company, Brazil, Ind., is the latest addition to the family of licensees of the Dunn Wire-Cut Lug Brick Company. The Indiana company has been in business for many years and has a high standing in the paving brick industry. The plant has a daily capacity of about 50,000 pavers and it is equipped with twenty-six kilns, 30 feet in diameter.

The corporate title of The Sandusky Portland Cement Company, Cleveland, Ohio, has recently been changed to that of "The Sandusky Cement Company," the officers and directors in the new company being the same as those of the old concern. There will be no other changes of any kind whatever, the business of the company being carried on as formerly, but the trade is requested to make special note of the new title and make use of the same in all correspondence.

The Keyport Engineering Co. has just placed a contract with the John W. Ferguson Co., of New York and Paterson, N. J., for a new factory building at the corner of Chansler avenue and Coyt street, Irvington, N. J. The building will consist of one story, 80 feet by 100 feet with brick walls and a sawtooth roof over half its length.

The Pittsburg-Des Moines Co., Pittsburg, Pa., have leased the Neville Island plant and taken over the business of the Pittsburg branch of the Des Moines Bridge and Iron Works, a change in name but not in management, and the business will be conducted as heretofore.

The Atlantic Vehicle Co., Newark, N. J,, published, in the form of diagrams, the results of the investigation made at the Massachusetts Institute of Technology into the cost of hauling by horse, gasoline and electric storage battery, which shows the greater economy of the latter.

The Koehring Machine Co., of Milwaukee, Wis., have moved their headquarters in Portland, Ore., to 254 East Hawthorne avenue., and at Seattle, Wash., to 1208 Western avenue. At each place is a spacious warehouse with a complete stock of Koehring mixers and parts, ready for immediate delivery. They are also distributers for the Northwest of the Sterling motor truck and the C. H. & E. saw rigs and pumps and carry complete stocks of each at these warehouses.

Pump for Testing Water Mains and to Supply Concrete Mixers

One of the designs of the Atlantic pumping engine, sold by Harold L. Bond Company, 383 Atlantic avenue, Boston, Mass., is fitted for testing water mains under pressure, providing an inexpensive, portable, dependable method for making construction tests, which will give the contractor protection and the engineer satisfaction. It is a 3½-h.p. gasoline engine with 5-inch bore, 6-inch stroke and speed of 350 to 550 r.p.m., connected by direct cut gear to double-acting 2½-inch bore, high-pressure pump, together with Pyramid 5 by 5 double-acting pump connected up to engine shaft with Whitney roller chains and machine-cut sprockets, enclosed in dust-tight housings. A relief valve on the discharge of the large pump discharges when the main is full of water and the handle of the 3-way cock at suction of large pump is turned, cutting off the water from the large pump and leaving only the small pump in operation. This reduces the load on the engine and allows the pressure to be carried up to any point desired by means of the small pump. A check valve in the discharge of the large pump keeps the water at high pressure from thelow-pressure reliev valve. The gage and relief valve can be set for any desired duty up to 300 pounds. The capacity of the two pumps together at 90 pounds pressure is 2,880 gallons an hour.

One important use for these pumps is to supply water to boilers for operating concrete mixers and other construction plants and for the concrete when it must be piped for some distance thru temporary lines.

Florida's Brick Roads

Florida these days is "eating brick." The building of brick roads has been given a strong impetus during the past year by the introduction of new constructional methods which make for durability. In Volusia county recently a contract was let to the Southern Clay Manufacturing Company, of Chattanooga, Tenn., for 200,000 yards of 3½-inch wire-cut-lug brick pavement, in the Deland-Lake Helen district, the brick to be laid on edge on a natural soil foundation and grouted. This road will be about 26 miles long, and 9 feet wide, except in Deland. In the latter place, the roadway will be paved 50 feet wide. Many miles of this type of road were constructed in Orange county in 1915, and a large amount of yardage will be built in other sections during the current calendar year.

Portable Steel Building

Kahn portable steel buildings are completely illustrated and described in a new catalog. The whole idea of these portable buildings has been developed along new and original lines. They are substantial buildings of exceptional quality, not to be compared with the ordinary, flimsy, light-gage materials that have often been sold for portable buildings.

The field of usefulness of Kahn portable buildings is practically unlimited, covering the range from the smallest garage to large general shops for manufacturing purposes, and including contractors' houses, hospital buildings, school houses, factory buildings of all types, summer cottages, boat houses, election booths, etc.